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ANNEX

ANNEX

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on the sectoral reference document on best environmental management practices, sector-specific environmental performance indicators and benchmarks of excellence for the waste management sector under Regulation (EC) No 1221/2009 on the voluntary participation by organisations in a Community eco-management and audit scheme (EMAS)

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1. INTRODUCTION

This sectoral reference document (SRD) is based on a detailed science for policy report[1] ("Best Practice Report") developed by the European Commission's Joint Research Centre (JRC).

Relevant legal background

The Community eco-management and audit scheme (EMAS) was introduced in 1993, for voluntary participation by organisations, by Council Regulation (EEC) No 1836/93[2]. Subsequently, EMAS has undergone two major revisions:

- Regulation (EC) No 761/2001 of the European Parliament and of the Council[3];
- Regulation (EC) No 1221/2009 of the European Parliament and of the Council.

An important new element of the latest revision, which came into force on 11 January 2010, is Article 46 on the development of SRDs. The SRDs have to include best environmental management practices (BEMPs), environmental performance indicators for the specific sectors and, where appropriate, benchmarks of excellence and rating systems identifying performance levels.

How to understand and use this document

The eco-management and audit scheme (EMAS) is a scheme for voluntary participation by organisations committed to continuous environmental improvement. Within this framework, this SRD provides sector-specific guidance to the waste management sector and points out a number of options for improvement as well as best practices. This SRD is without prejudice to legal requirements in the relevant field.

The document was written by the European Commission using input from stakeholders. A Technical Working Group, comprising experts and stakeholders of the sector, led by the JRC, discussed and ultimately agreed on the best environmental management practices, sector-specific environmental performance indicators and benchmarks of excellence described in this document; these benchmarks in particular were deemed to be representative of the levels of environmental performance that are achieved by the best performing organisations in the sector.

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[1] The science for policy report is publicly available on the JRC website at the following address: http://susproc.jrc.ec.europa.eu/activities/emas/documents/WasteManagementBEMP.pdf. The conclusions on best environmental management practices and their applicability as well as the identified environmental performance indicators and the benchmarks of excellence contained in this Sectoral Reference Document are based on the findings documented in the science for policy report. All the background information and technical details can be found there. The full reference of the science for policy report is: Dri M., Canfora P., Antonopoulos I. S., Gaudillat P., Best Environmental Management Practice for the Waste Management Sector, JRC Science for Policy Report, EUR 29136 EN, Publications Office of the European Union, Luxembourg, 2018, ISBN 978-92-79-80361-1, doi:10.2760/50247, JRC111059.

[2] Council Regulation (EEC) No 1836/93 of 29 June 1993 allowing voluntary participation by companies in the industrial sector in a Community eco-management and audit scheme (OJ L *168, 10.7.1993, p. 1)*.

[3] Regulation (EC) No 761/2001 of the European Parliament and of the Council of 19 March 2001 allowing voluntary participation by organisations in a Community eco-management and audit scheme (EMAS) (*OJ L 114, 24.4.2001, p. 1)*.

The SRD aims to help and support all organisations that intend to improve their environmental performance by providing ideas and inspiration as well as practical and technical guidance.

The SRD is primarily addressed to organisations that are already registered with EMAS; secondly to organisations that are considering registering with EMAS in the future; and thirdly to all organisations that wish to learn more about best environmental management practices in order to improve their environmental performance. Consequently, the objective of this document is to support all organisations in the waste management sector to focus on relevant environmental aspects, both direct and indirect, and to find information on best environmental management practices, as well as appropriate sector-specific environmental performance indicators to measure their environmental performance, and benchmarks of excellence.

How SRDs should be taken into account by EMAS registered organisations:

Pursuant to Regulation (EC) No 1221/2009, EMAS registered organisations are to take SRDs into account at two different levels:

When developing and implementing their environmental management system in light of the environmental reviews *(Article 4(1)(b));*

> Organisations should use relevant elements of the SRD when defining and reviewing their environmental targets and objectives in accordance with the relevant environmental aspects identified in the environmental review and policy, as well as when deciding on the actions to implement to improve their environmental performance.

When preparing the environmental statement *(Article 4(1)(d) and Article 4(4)).*

> Organisations should consider the relevant sector-specific environmental performance indicators in the SRD when choosing the indicators[4] to use for their reporting of environmental performance.
>
> When choosing the set of indicators for reporting, they should take into account the indicators proposed in the corresponding SRD and their relevance with regards to the significant environmental aspects identified by the organisation in its environmental review. Indicators need only be taken into account where relevant to those environmental aspects that are judged as being most significant in the environmental review.
>
> When reporting on environmental performance and on the other factors regarding environmental performance the organisations should mention in the environmental

[4] According to Annex IV (B.f.) of the EMAS Regulation, the environmental statement shall contain "*a summary of the data available on the environmental performance of the organisation with respect its significant environmental aspects. Reporting shall be on both the core environmental performance indicators and the specific environmental performance indicators as set out in Section C"*. Annex IV - Section C.3 states that "*each organisation shall also report annually on its performance relating to the significant direct and indirect environmental aspects and impacts that are related to its core business activities, that are measurable and verifiable, and that are not covered already by the core indicators. Reporting on those indicators shall be done in accordance with the requirements set in the introduction to this section. Where available, the organisation shall take account of sectoral reference documents as referred to in Article 46 to facilitate the identification of relevant sector specific indicators.*"

statement how the relevant best environmental management practices and, if available, benchmarks of excellence, have been taken into account.

They should describe how relevant best environmental management practices and benchmarks of excellence (which provide an indication of the environmental performance level that is achieved by best performers) were used to identify measures and actions, and possibly to set priorities, to (further) improve their environmental performance. However, implementing best environmental management practices or meeting the identified benchmarks of excellence is not mandatory, because the voluntary character of EMAS leaves the assessment of the feasibility of the benchmarks and of the implementation of the best practices, in terms of costs and benefits, to the organisations themselves.

Similarly to environmental performance indicators, the relevance and applicability of the best environmental management practices and benchmarks of excellence should be assessed by the organisation according to the significant environmental aspects identified by the organisation in its environmental review, as well as technical and financial aspects.

Elements of SRDs (indicators, BEMPs or benchmarks of excellence) not considered relevant with regards to the significant environmental aspects identified by the organisation in its environmental review should not be reported or described in the environmental statement.

EMAS participation is an ongoing process. Every time an organisation plans to improve its environmental performance (and reviews its environmental performance) it shall consult the SRD on specific topics to find inspiration about which issues to tackle next in a step-wise approach.

EMAS environmental verifiers shall check if and how the SRD was taken into account by the organisation when preparing its environmental statement (Article 18(5)(d) of Regulation (EC) No 1221/2009).

When undertaking an audit, accredited environmental verifiers will need evidence from the organisation of how the relevant elements of the SRD have been selected in light of the environmental review and taken into account. They shall not check compliance with the described benchmarks of excellence, but they shall verify evidence on how the SRD was used as a guide to identify indicators and proper voluntary measures that the organisation can implement to improve its environmental performance.

Given the voluntary nature of EMAS and SRD, no disproportionate burdens should be put on the organisations to provide such evidence. In particular, verifiers shall not require an individual justification for each of the best practices, sector-specific environmental performance indicators and benchmarks of excellence which are mentioned in the SRD and not considered relevant by the organisation in the light of its environmental review. Nevertheless, they could suggest relevant additional elements for the organisation to take into account in the future as further evidence of its commitment to continuous performance improvement.

Structure of the document

This document consists of four sections. Section 1 introduces EMAS' legal background and describes how to use this document, while section 2 defines the scope of this reference document. Section 3 briefly describes the different Best Environmental Management Practices

(BEMPs)[5], together with information on their applicability. When specific environmental performance indicators and benchmarks of excellence could be formulated for a particular BEMP, these are also given. In case indicators and benchmarks are relevant for more than one BEMP, they are repeated whenever appropriate. Section 3 also defines, in addition to the indicators set in the individual BEMPs, a number of environmental performance indicators that can be used to assess the overall performance of municipal solid waste management systems. Defining benchmarks of excellence was not possible for all BEMPs and indicators either because of the limited availability of data or because the specific conditions of each waste authority or waste management company (e.g. rural or urban territory, type of separate collection and waste management system adopted, local consumption patterns) vary to such an extent that a benchmark of excellence would not be meaningful. Even when benchmarks of excellence are given, these are not meant as targets for all waste authorities or waste management companies to reach or metrics to compare the environmental performance across the sector, but rather as a measure of what is possible to help individual organisations assess the progress they made and motivate them to improve further.

Finally, Section 4 presents a comprehensive table with a selection of the most relevant environmental performance indicators, associated explanations and related benchmarks of excellence.

[5] A detailed description of each of the best practices, with practical guidance on how to implement them, is available in the science for policy report published by the JRC and available on-line at the following address: http://susproc.jrc.ec.europa.eu/activities/emas/documents/WasteManagementBEMP.pdf. The reader is invited to consult it if interested to learn more about some of the best practices described in this document.

2. SCOPE

This Sectoral Reference Document addresses two types of organisations of the waste management sector: waste management companies (public and private), including companies implementing producer responsibility schemes, and waste authorities (public administrations in charge of waste management, mainly at local level). Such organisations are included in the following NACE codes (according to the statistical classification of economic activities established by Regulation (EC) No 1893/2006[6]):

- 38.1 - waste collection;
- 38.2 - waste treatment and disposal;
- 38.3 - materials recovery;
- 39.0 - remediation activities and other waste management services;
- 84.1 - administration of the State and the economic and social policy of the community.

This Sectoral Reference Document does not cover the activities of organisations that generate waste and do not belong to the waste management sector (i.e. most organisations).

This Sectoral Reference Document describes best practices for the following waste management phases and activities:

- establishing a waste management strategy;
- fostering waste prevention;
- promoting the re-use of products and preparation for re-use of waste;
- improving waste collection;
- waste treatment, limited to operations enabling material recycling.

In the area of waste treatment, the scope of this Sectoral Reference Document is limited to facilities performing treatments outside the scope of the Industrial Emissions Directive[7] (e.g. sorting facilities with the aim to recycle plastics).

This Sectoral Reference Document deals with three waste streams:

- municipal solid waste (MSW): household waste and waste from other sources, such as retail, administration, education, health services, accommodation and food services, and other services and activities, which is similar in nature and composition to waste from households;
- construction and demolition waste (CDW);
- healthcare waste (HCW).

Industrial waste and commercial waste that is not part of MSW are not covered in this document.

This reference document is divided into five main sections (Table 2-1) which cover, from the perspective of the target organisations, the main environmental aspects related to the management of waste.

[6] Regulation (EC) No 1893/2006 of the European Parliament and of the Council of 20 December 2006 establishing the statistical classification of economic activities NACE Revision 2 and amending Council Regulation (EEC) No 3037/90 as well as certain EC Regulations on specific statistical domains (OJ L 393, 30.12.2006, p. 1).

[7] Directive 2010/75/EU of the European Parliament and the Council on industrial emissions

Table 2-1: Structure of the SRD for the waste management sector and main environmental aspects addressed.

Section	Description	Main environmental aspects addressed
3.1 Cross-cutting BEMPs	This section deals with cross-cutting best practices that apply to all waste streams covered in this document, from setting a waste strategy, to the use of economic instruments and to finding additional best practices in other EU reference documents.	Waste prevention measures Waste collection Waste sorting, preparation for re-use and treatment Transport operations Energy recovery of waste Waste disposal
3.2 BEMPs for MSW	This section presents how waste authorities and waste management companies can best manage MSW, including the design of the strategy, waste prevention, product re-use and preparation for re-use of waste, waste collection and waste treatment operations. The section also includes a BEMP addressing Producer Responsibility Organisations.	Waste prevention measures Waste collection Waste sorting, preparation for re-use and treatment Transport operations Energy recovery of waste Waste disposal
3.3 Common environmental performance indicators for MSW	This section presents common environmental performance indicators that can be used to assess the overall performance of municipal solid waste management systems	Waste prevention measures Waste collection Waste sorting, preparation for re-use and treatment Transport operations Energy recovery of waste Waste disposal
3.4 BEMPs for CDW	This section focuses on the activities of waste authorities and waste management companies directly or indirectly responsible for the management of CDW. The main areas addressed are CDW management plans, avoiding PCB contamination of CDW, management of removed waste asbestos and processing of waste plasterboard and CDW for recycling.	Waste prevention measures Waste collection Waste sorting and treatment Transport operations Waste disposal

3.5 BEMPs for HCW	This section presents how waste authorities and waste management companies can best deal with the management of HCW. The main areas covered are the optimisation of HCW segregation and the adoption of alternative treatments for HCW.	Waste collection Waste treatment Waste disposal

For each of the main environmental aspects identified in Table 2-1, Table 2-2 presents the related main environmental impacts addressed in this document. The environmental aspects presented in Table 2-1 and Table 2-2 were selected as the most commonly relevant in the sector. However, the environmental aspects to be managed by specific companies need to be assessed on a case-by-case basis.

Table 2-2: Most relevant environmental aspects and related main environmental impacts addressed in this document

Main environmental aspects	**Main environmental impacts**
Waste collection	- Climate change (GHG emissions) - Emissions to air - Natural resources depletion
Waste prevention measures	- Climate change (GHG emissions) - Emissions to air - Natural resources depletion
Waste sorting, preparation for re-use and treatment	- Climate change (GHG emissions) - Emissions to air/water/land - Natural resources depletion - Land use
Transport operations	- Climate change (GHG emissions) - Emissions to air - Natural resources depletion
Energy recovery of waste	- Climate change (GHG emissions) - Emissions to air/water/land - Natural resources depletion - Land use
Waste disposal	- Climate change (GHG emissions) - Emissions to air/water/land - Natural resources depletion - Land use

3. BEST ENVIRONMENTAL MANAGEMENT PRACTICES, SECTOR ENVIRONMENTAL PERFORMANCE INDICATORS AND BENCHMARKS OF EXCELLENCE FOR THE WASTE MANAGEMENT SECTOR

3.1. Cross-cutting BEMPs

BEMPs presented in this section deal with cross-cutting issues of waste management that are relevant for all the waste streams considered (i.e. municipal solid waste, construction and demolition waste and healthcare waste).

3.1.1. Integrated waste management strategies

It is BEMP to develop and implement an integrated waste management strategy that considers:

- the current and future expected trends of waste streams;
- the waste hierarchy[8], prioritising measures according to the hierarchy (firstly waste prevention, secondly preparation for re-use, etc.);
- the availability and capacity of nearby waste sorting/treatment facilities;
- the current environmental attitudes and perceptions of residents;
- any other specific condition affecting waste management (e.g. the significant presence of tourists/commuters, specific economic activities, climate).

The development of a waste management strategy requires knowledge of the quantity and quality of each major waste stream through an appropriate data monitoring approach and a sound evaluation of waste management options. This may require, in some cases, the use of a life-cycle assessment (LCA) to identify options associated with the best environmental performance (see BEMP 3.1.2), which may sometimes depart from the waste hierarchy.

Applicability

This BEMP is primarily targeted to waste authorities with control, or at least significant influence over, waste management strategy at the local or regional level – primarily local authorities. The waste authority may need to outsource aspects of strategic planning where particular specialist expertise, such as analytical data skills and knowledge of waste treatment processing, are required.

Associated environmental performance indicators and benchmarks of excellence

Environmental performance indicators	Benchmarks of excellence
(i1) Overall targets for the improvement of the waste management system (e.g. based on the indicators defined in this document) are in place (y/n). (i2) Specific targets for waste prevention and reuse are in place (y/n).	(b1) An integrated waste management strategy that includes long-term (i.e. 10–20 years) and short-term (i.e. 1–5 years) overall targets for the improvement of the performance of the waste management system is in place and regularly reviewed (at least every 3 years).

[8] The waste hierarchy consists of the following steps: waste prevention, preparation for re-use, recycling, recovery and disposal.

3.1.2. Life cycle assessment of waste management options

It is BEMP to embed life-cycle thinking and assessment into waste management strategy and operations, with steps 1 and 2 (below) being essential and steps 3 to 8 needing an ad-hoc life-cycle assessment (LCA) to be carried out and not always necessary:

1) Systematic application of life-cycle thinking throughout waste management strategy design and implementation (to complement the waste management hierarchy).
2) Review of relevant LCA literature to rank the environmental performance of alternative waste management options, where studied systems are directly comparable with available options.
3) Application of LCA to specific management and technology options for which no reliable published literature can be found; this requires procurement of LCA services, or in-house use of relevant LCA software.
4) The careful consideration of system boundaries, that ensures an accurate comparison across waste management options, includes system expansion and/or LCA for avoided processes (e.g. grid electricity generation).
5) Compilation and documentation of life-cycle inventories in relation to reference flows, if possible using primary data recorded along the value chain, noting data quality and uncertainty ranges.
6) Selection of pertinent impact categories to capture the major environmental burdens.
7) Presentation of normalised results for relevant impact categories to evaluate complementarities or trade-offs, with clear indication of uncertainty errors and sensitivity analyses.
8) Validation of the LCA study by an independent third party (essential requirement under ISO 14044[9] for external dissemination of results, but good practice even when only used internally).

Applicability

A full life-cycle assessment is not always necessary. Basic prioritisation of the waste management options indicated in the waste management hierarchy may be sufficient to inform best practice in some cases. However, detailed comparison of options ranked similarly in the waste hierarchy and of management changes that affect the overall waste chain performance are often required.

Waste management organisations of any size may apply life-cycle thinking and review LCA studies. Buying bespoke LCA services and/or paying for staff training in LCA may only be economically viable for larger organisations.

Associated environmental performance indicators and benchmarks of excellence

Environmental performance indicators	Benchmarks of excellence
(i3) Systematic application of life-cycle thinking, and, where necessary, undertaking of life-cycle assessments, throughout waste management strategy design and implementation (y/n).	(b2) The waste management strategy is designed and implemented on the basis of systematic application of life-cycle thinking and, when needed, ad-hoc life-cycle assessment studies.

[9] ISO 14044:2006: Environmental management - Life cycle assessment - Requirements and guidelines

3.1.3. Economic instruments

It is BEMP to use economic instruments, to steer the behaviour of citizens and organisations generating waste towards more environmentally friendly results. Economic instruments can support:

- reducing the amount of waste generated or reducing the proportion of hazardous waste;
- encouraging preparation for reuse and recycling of waste; decreasing incineration and landfilling;
- improving product design (e.g. encouraging the use of recyclable materials in products).

The economic instruments related to waste management cover both incentives (positive economic signals, e.g. discounts, reward vouchers) and disincentives (negative economic signals, e.g. taxes, fees, penalties) and can take the form of:

- taxes and tax modulation, e.g. waste disposal tax, landfill tax, incineration tax;
- product levies (e.g. on plastic bags or construction aggregates);
- waste pricing, such as unit-based pricing and pay-as-you-throw (PAYT) schemes;
- deposit-refund schemes;
- extended producer responsibility schemes;
- others, e.g. tradable permits, recycling subsidies, VAT exemptions.

Applicability

The regulatory framework and its enforcement are the main barriers for the application of economic instruments at local level.

In addition, the existence of environmental awareness, good management skills and innovation-driven behaviour at the local government level, with some good accounting practices, are prerequisites for the implementation of local economic instruments, which are complex to manage from the technical, managerial and social perspectives.

Associated environmental performance indicators and benchmarks of excellence

Environmental performance indicators	Benchmarks of excellence
(i4) Use of economic instruments at local level to stimulate good behaviour (y/n). (i5) Share of residents/businesses using a voluntary economic instrument (%).	(b3) Economic instruments set at local level in the form of taxes and tax modulation, product levies, waste pricing, extended producer responsibility schemes and deposit-refund schemes are systematically implemented as a mean to achieve the objectives set in the local waste management strategy. (b4) For local authorities, a deposit refund scheme for glasses, cups, dishes and cutlery is in place for all festivals and large public events organised in the territory of the local authority.

3.1.4. Link to other relevant reference documents for best practices

It is BEMP to implement state-of-the-art techniques that maximise resource efficiency and minimise environmental impact in the areas of waste treatment (including material recycling, energy recovery and waste disposal). Useful reference documents (non-exhaustive list) on relevant state-of-the-art techniques that organisations can refer to are:

- Reference Document on Best Available Techniques for Waste Treatment[10];
- End-of-waste criteria[11];
- Reference Document on Best Available Techniques for Waste Incineration;
- EU Landfill Directive (99/31/EC)[12].

Applicability

This BEMP is targeted to local waste authorities and waste management companies planning and carrying out operations in the areas of waste treatment, material recycling, energy recovery and waste disposal.

Associated environmental performance indicators and benchmarks of excellence

Environmental performance indicators	Benchmarks of excellence
(i6) Relevant state-of-the-art techniques described in the reference documents listed in this BEMP are implemented (y/n).	-

3.2. BEMPs for municipal solid waste

BEMPs presented in this section deal with the management of municipal solid waste (MSW).

Strategy BEMPs

3.2.1. Cost benchmarking

Choices related to waste management are greatly affected by economic factors; carrying out cost benchmarking by comparing the cost structure of a municipality with data of other municipalities is BEMP as it allows the identification of optimisation options which may open the door to more environmentally friendly practices. Cost benchmarking can be carried out internally, by an independent third party or in cooperation with other municipalities. Cost figures analysed typically include costs for waste management services and for the disposal of certain waste fractions as well as revenues gained from the sale of waste that is sent to preparation for re-use or recycling and other by-products.

All relevant waste fractions generated within the territory considered and belonging to MSW need to be taken into account in the cost benchmarking. Comprehensive analyses include

[10] For more information on the content of the Best Available Techniques Reference Documents and a full explanation of terms and acronyms, please refer to the European Integrated Pollution Prevention and Control Bureau website: http://eippcb.jrc.ec.europa.eu/.

[11] End-of-waste criteria were introduced by Article 6 of the Waste Framework Directive of December 2008 (2008/98/EC). More information is available at: http://ec.europa.eu/environment/waste/framework/end_of_waste.htm

[12] For more information on the content on the Landfill Directive and access to the full text, please refer to the following website: http://ec.europa.eu/environment/waste/landfill_index.htm.

costs for waste collection, waste treatment (sorting, recovery, disposal, etc.) including the management of closed landfills, staff costs and all other waste-management-related costs.

Applicability

Cost benchmarking can be applied within an area (at local or national level) where waste management conditions are comparable and where there is a uniform legal framework. However, in some cases, strong deviations occur due to specific conditions. Cost benchmarking is particularly relevant for areas with poorly performing waste management systems, in order to support the shift to better performing waste management options.

Associated environmental performance indicators and benchmarks of excellence

Environmental performance indicators	Benchmarks of excellence
(i7) Regular participation in a detailed cost benchmarking study (y/n). (i8) Total MSW management cost per resident per year (EUR/capita/year).	-

3.2.2. Advanced waste monitoring

The development and implementation of an efficient and effective waste management strategy is based on detailed knowledge of statistical data for the waste streams collected and managed at local level.

It is thus BEMP to:

- regularly collect and process available data at single waste stream level, and for the different steps of the collection, reuse/preparation for reuse, sorting, recycling, recovery and disposal processes;
- regularly carry out a composition analysis of the mixed waste;
- when waste management operations are contracted out, include contract clauses for the systematic communication of comprehensive data.

Waste monitoring data are useful both for internal analysis (such as evaluating the potential implementation of a new measure) and for sharing with the relevant public administration and citizens to drive improvement and awareness.

Applicability

Detailed waste monitoring is applicable to all local authorities and waste management companies managing municipal solid waste. For organisations starting the process, waste monitoring may focus first on the most relevant waste fractions and eventually be extended to all fractions step by step.

Associated environmental performance indicators and benchmarks of excellence

Environmental performance indicators	Benchmarks of excellence
(i9) Use of web-based tools for tracking and reporting waste data (y/n). (i10) Frequency of composition analysis of mixed waste (one composition analysis every # months	(b5) Composition analysis of mixed waste is carried out at least four times a year (during different seasons) every three years or after any substantial

or years).	change of the waste management system.

3.2.3. Pay-as-you-throw

The aim of pay-as-you-throw (PAYT) is to enact the polluter pays principle in a fair way by charging users of the waste management system according to the amount of waste they generate.

It is BEMP to charge waste fees to users based on a fixed plus variable fee component, to reflect the cost structure of waste management and align incentives for users (i.e. lower fee when less waste is produced) and waste collectors (i.e. revenue stability from the fixed fee component).

In practice, the system can be implemented in various forms, typically:

- volume-based schemes (choice of container size);
- sack-based schemes (number of waste sacks used), e.g. with prepaid specific sacks;
- weight-based schemes (the weight of the waste collected in a given container);
- frequency-based schemes (the frequency with which a container is left out for collection – this approach can be combined with volume- and weight-based schemes).

The scheme can be focused on charging for residual waste only or also separated streams, still with the aim of fostering source separation and waste prevention.

The four key elements enabling the implementation of a PAYT scheme are:

- the identification of individual users[13];
- the measurement of waste streams at the individual user level (e.g. from door-to-door collection, street containers or at civic amenity sites);
- the definition of a unit pricing that effectively drives behavioural change;
- the engagement of residents to ensure a correct understanding of the features of the scheme and their buy-in and commitment (this is important to avoid illegal dumping or the transfer of waste in other territories not served by a PAYT scheme).

Applicability

While the approach is broadly applicable, existing infrastructure must be adapted (e.g. collection). Door-to-door collection is usually necessary to fully implement PAYT principles.

Precautions must be taken to ensure that enforcement is ensured (e.g. no 'leakage' into the MSW of adjacent local authorities with no PAYT or into litter bins on the streets). This is more feasible when there is already an existing awareness of users regarding source-separation and broader environment and waste issues.

Depending on the implementation (e.g. in case of user identification of individual bins or bags), appropriate measures are needed to deal correctly with data privacy and confidentiality (e.g. secure data storage).

Associated environmental performance indicators and benchmarks of excellence

Environmental performance indicators	**Benchmarks of excellence**

[13] The first two elements are not needed in PAYT schemes based on prepaid sacks.

(i11) A pay-as-you-throw system is in place (y/n). (i12) Inclusion of waste conferred to civic amenity sites in the PAYT system (y/n). (i13) Share of users with zero waste generation (%).	(b6) A pay-as-you-throw system is in place, according to which at least 40 % of the cost is charged to the users depending on the quantity (kg or m^3) of mixed waste collected, the size of the waste collection bins and/or the number of collection rounds. (b7) The PAYT system also includes the waste conferred to civic amenity sites.

3.2.4. Performance-based waste management contracting

It is BEMP for local authorities that contract out the delivery of certain MSW management services to private suppliers to include performance-based contract clauses. Performance-based contracting can ensure that both environmental and financial objectives are met.

Three main characteristics are inherent to a performance-based contract:

- definition of a series of objectives and indicators to measure contractor performance;
- collection of data on the performance indicators to assess the implementation of the service;
- good or bad performance impacting the contractor (higher revenue or penalties).

It is important for local authorities to base the performance clauses on a full set of indicators (for example taking inspiration from the indicators presented in Section 3.3) and appropriate monitoring. Special care needs to be taken in defining a baseline and bearing in mind the influence of the variation in external conditions (economic, social, regulations, etc.) on the benchmark mechanism.

Applicability

The existence of an effective waste management performance monitoring system is a prerequisite to performance-based waste monitoring system (building on internal management practices to expand to contract management).

When switching to a performance-based contract for the first time, it is also important to establish a dialogue with the prospective contractors and all stakeholders involved, in order to learn what is technically achievable and economically feasible.

Associated environmental performance indicators and benchmarks of excellence

Environmental performance indicators	Benchmarks of excellence
(i14) Share of the contract value depending on the achievement of the environmental objectives or of the defined environmental performance levels (%). (i15) Customer satisfaction (% of residents satisfied with household waste collection and specifically with the collection of the separately collected fractions).	-

3.2.5. Awareness-raising

Best practice in awareness-raising is to effectively encourage waste prevention, reuse and recycling behaviour within the waste collection catchment area. Ultimately, this should translate into improved performance across key waste generation and separation indicators.

Best practice awareness-raising campaigns need to:

- ensure continuity, consistency, complementarity and clarity of all communications with well-defined aims and objectives;
- create clear messages appropriate to, and directed at, well-defined target audiences;
- ensure efficient delivery through the integration of activities and clear lines of responsibility.

Examples of two major barriers to recycling that may be overcome by awareness raising are:

- lack of knowledge: not knowing which waste materials to put in which container, or not understanding the local recycling scheme (e.g. collection days, etc.).
- attitudes and perceptions: not accepting there is a need to recycle, being insufficiently motivated to avoid and sort waste.

Awareness campaigns for citizens may be delivered directly by the waste management organisation, by professional agencies on their behalf, or by partner organisations (including stakeholders in other sectors).

A whole range of communication channels can be used, which can include advertising, public relations, direct marketing, community engagement, online engagement, social media and product labelling.

Applicability

Awareness-raising can be implemented at some level in any context.

Associated environmental performance indicators and benchmarks of excellence

Environmental performance indicators	Benchmarks of excellence
(i16) Budget spent on awareness-raising per resident per year (EUR/capita/year). (i17) Share of total MSW management budget spent on awareness-raising (%). (i18) Share of population in the waste management catchment area having received awareness-raising messages over a given time period (e.g. % of population per month).	(b8) Awareness campaigns are systematically implemented for different types of target groups (e.g. pupils, general public, users of civic amenity sites) and the annual budget devoted to awareness-raising activities is at least EUR 5 per resident.

3.2.6. Establishment of a network of waste advisers

It is BEMP to set up a network of waste advisers (also called “waste (prevention) officers”, “recycling officers”, “waste (prevention) consultants”) at local level in order to raise the awareness of the general public (residents and small businesses delivering their waste to the local MSW management system).

The use of waste advisers is especially relevant to address specific issues by targeting a specific territory or audience with a poor separate collection rate or high contamination in

separately collected fractions in order to deliver an adapted answer, as waste advisers can interact face to face.

Waste advisers typically have a prior qualification in the environmental field as well as knowledge of the practices of waste minimisation, reuse and recycling, and can be volunteers, part-time or full-time staff. Waste advisers can perform a range of activities, such as:

- make residents and small businesses aware of the environmental issues related to waste generation and management;
- inform residents and small businesses about the waste collection rules and how the different fractions are treated and recycled;
- provide residents and small businesses with guidance to identify possibilities to reduce or better manage (e.g. better source separation) their waste;
- work with residents and small businesses on specific waste streams that are considered more problematic (food waste, textiles, nappies, etc.);
- carry out engagement actions targeted to specific audiences (e.g. children/teenagers, pensioners, businesses, foreign-language speakers);
- gain a better understanding of what happens on the ground (drivers, reasons, shortfalls).

Applicability

This BEMP can be implemented at any level. However, waste advisers' scope of action is more focused on the local level since they address operational issues (waste prevention and recycling guidelines).

Associated environmental performance indicators and benchmarks of excellence

Environmental performance indicators	**Benchmarks of excellence**
(i19) Share of population in the waste management catchment area advised by waste advisers over a given time period (e.g. % of population per month). (i20) Number of waste advisers per 100 000 residents.	(b9) A network of waste advisers is in place with at least one waste adviser per 20 000 residents.

3.2.7. Home and community composting

In cases when home and community composting is the most appropriate waste management option for biowaste based on the waste management strategy adopted and/or on an LCA study on waste management options (see sections 3.1.1 and 3.1.2), it is BEMP to:

- Systematically deploy and promote home and community composting, keeping track of the number of residents involved, registering where composting equipment is installed and operated.
- Organise initial awareness-raising campaigns through graphic material, public meetings, waste advisers, etc. (see sections 3.2.5 and 3.2.6) informing and training residents about home and community composting, its benefits, its correct operation (in order to limit methane emissions and pollution to soil, and ensure that the output is good quality compost), which biowaste is suitable, etc.

- Regularly update and train residents on the correct operation of home and community composting.
- Regularly monitor home and community composting sites. A number of representative sites can be inspected every year to check the correct operation of composting and ensure its environmental benefits.

Applicability

In cases when home and community composting is the most appropriate waste management option for biowaste, there are no major restrictions to implementing this BEMP. However, the success of home and community composting as an environmental management strategy is highly dependent on the management of the waste separation and composting process by citizens who must be first engaged to motivate them to separate organic waste, and then trained to correctly manage the composting process. Additional effort is required to organise home and community composting in urban areas.

Associated environmental performance indicators and benchmarks of excellence

Environmental performance indicators	Benchmarks of excellence
(i21) Share of population doing home composting or to which community composting is available (% of total population in the waste management catchment area). (i22) Share of population implementing home/community composting correctly, on the basis of an annual visit and analysis of the compost produced (% of the population doing home composting or to which community composting is available). (i23) System in place for regular follow-up with residents doing home composting (y/n). (i24) Share of home composters visited annually (% of the households doing home composting).	(b10) All residents have access to either separate collection of biowaste or home and community composting of biowaste.

BEMPs for waste prevention

3.2.8. Local waste prevention programmes

It is BEMP to put in place waste prevention measures that target both households and public and private organisations. Some examples are adoption of local plastic bag charges, support for the setup of repair shops, introduction of product/material exchange areas in the territory as well as cooperation with social economy organisations, NGOs and restaurants to encourage the development of agreements for the reduction of food waste, thanks to donations. Waste prevention measures can be identified by:

- assessing current waste generation patterns in the territory;
- prioritising the most relevant waste streams in terms of prevention potential, such as food waste and biowaste, paper/cardboard, plastic (packaging), glass and textiles;

- Elaborating a local waste prevention strategy involving the relevant stakeholders (e.g. residents, local businesses, social economy organisations, NGOs);
- Monitoring the results of the waste prevention measures adopted and, in light of the results, reviewing the waste prevention strategy.

Applicability

Waste prevention measures need to be carefully selected based on local circumstances and well implemented (e.g. some may need support by financial incentives) but there are suitable measures for any context.

Although some key waste prevention instruments can only be pursued at the international or national level (e.g. product policy, value-added taxation), there is also scope for action at the regional and local levels.

Associated environmental performance indicators and benchmarks of excellence

Environmental performance indicators	Benchmarks of excellence
(i25) Establishment of a local waste prevention plan, including long-term and short-term targets and provisions for regular monitoring (y/n). (i26) Budget dedicated to waste prevention programmes per resident per year (EUR/capita/year). (i27) Share of total MSW management budget devoted to waste prevention (%). (i28) Number of stakeholders involved in prevention programmes.	(b11) Waste prevention has strategic relevance in the waste management strategy, which includes a local waste prevention programme underpinning long-term (i.e. 10–20 years) and short-term (i.e. 1–5 years) waste prevention targets and including provisions for regular monitoring.

3.2.9. Schemes fostering the re-use of products and the preparation for re-use of waste

It is BEMP to encourage diversion of reusable products away from waste streams and into reuse streams, through the active establishment or facilitation of second-hand and municipal exchange markets (via repair workshops where necessary) or charity collections. Additionally, waste management organisations can send certain waste streams to preparation for reuse by establishing or facilitating the creation of reuse/repair centres.

The BEMP covers four key measures:

- collect products suitable for reuse before these are considered waste, repair them if needed, and distribute or sell them to residents and organisations, including charities;
- collect waste items suitable for reuse, have them prepared for reuse, and distribute or sell them to residents and organisations, including charities;
- establish effective information exchanges to advertise the demand for, and market the availability of, reusable used products;
- monitor the output (regardless of whether their input is classified as waste or product) of repair and reuse centres which have been accredited based on Annex IV to the Waste Framework Directive (2008/98/EC).

Applicability

This BEMP applies to all waste management organisations that handle any type of reusable items, in particular garments, furniture and electrical and electronic equipment.

Associated environmental performance indicators and benchmarks of excellence

Environmental performance indicators	Benchmarks of excellence
(i29) Number of reuse centres/community repair points per 100 000 residents. (i30) Number or quantity (i.e. weight or volume) of end-of-life products collected for reuse and waste items sent for preparation for reuse. (i31) Annual number of customers of the reuse centres/community repair points. (i32) Availability of products/materials exchange areas aimed at fostering reuse in civic amenity sites (y/n).	(b12) In civic amenity sites, products/materials exchange areas aimed at fostering reuse are available.

BEMPs for waste collection

3.2.10. Waste collection strategy

It is BEMP to design and implement a waste collection strategy that considers:

- the main features of the waste management strategy (e.g. number of separately collected waste fractions);
- the targets set in the waste management strategy (e.g. share of separately collected waste out of the total waste collected, impurity rates of the separately collected fractions, revenues from recyclables);
- the characteristics of the collection area (e.g. population density and main housing types);
- the current environmental attitudes and perceptions of residents;
- any other specific condition affecting waste collection (e.g. the relevant presence of tourists/commuters, specific economic activities, climate).

The main goal of a waste collection strategy is to collect, in a timely and economical manner, as much correctly source separated waste as possible, in order to ease the subsequent waste sorting/treatment with the aim to maximise recycling. In many cases, these objectives can be pursued by setting up the following:

- frequent door-to-door separate collection of food waste (e.g. weekly or more often depending on the season and climate);
- less frequent collection of mixed waste (e.g. every two weeks);
- door-to-door collection of recyclables (e.g. paper, cardboard, cans, plastics, glass), individually source separated where public acceptability allows, otherwise co-mingled and sorted at a material recovery facility; glass, followed by paper and cardboard, is more often more effectively collected separately;
- a convenient network of civic amenity sites (see section 3.2.12) that accept all waste fractions not collected door-to-door or in street containers from households, including hazardous waste and biowaste.

Applicability

The prevailing socio-economic status and recycling consciousness within the area from which waste is collected needs to be considered in the definition of the waste collection strategy. More costly strategies, such as door-to-door collection, may prove more cost-effective once fully running, but require initial investment.

Associated environmental performance indicators and benchmarks of excellence

Environmental performance indicators	Benchmarks of excellence
(i33) Participation rate, i.e. the share of the population using the waste collection system[14] (%). (i34) Share of the local area covered with a specific waste collection system (%). (i15) Customer satisfaction (% of residents satisfied with household waste collection and specifically with the collection of the separately collected fractions). (i35) Collection of bulky waste on demand (y/n).	(b13) Door-to-door waste collection of at least four waste fractions[15] is implemented in the whole territory in which MSW is managed.

3.2.11. Inter-municipal cooperation among small municipalities

It is BEMP for small and medium municipalities to adopt inter-municipal cooperation that allows the implementation of measures that would be too costly for them to implement alone and can result in the improved environmental performance of the waste management system. Municipalities can join together to operate or contract out some waste management services, with the aim of delivering economies of scale and building critical mass.

Inter-municipal cooperation makes it possible for the municipalities involved to:

- share administrative overheads,
- reduce unit costs and improve service quality through economies of scale,
- attract investment funds reserved for projects of a specified minimum size (e.g. EU structural funds and other investment mechanisms) and
- enhance economic performance through coordinated planning while allowing better environmental protection.

Applicability

There are no specific barriers for the application of inter-municipal cooperation in waste management. However, benefits from the economy of scale are only evident for small and medium municipalities.

Associated environmental performance indicators and benchmarks of excellence

Environmental performance indicators	Benchmarks of excellence

[14] Data is usually available, based on estimations, surveys, how often the bin for recyclables is left out for collection, etc.

[15] In areas where different waste fractions are collected co-mingled (e.g. metal and plastic waste packaging) the co-mingled fraction is considered one fraction.

(i36) Implementation of inter-municipal cooperation with other municipalities (y/n).	-

3.2.12. Civic amenity sites

As a key complement to an effective door-to-door (kerbside) collection of the most common waste fractions, it is BEMP to run civic amenity sites (also called container parks, collection centres, clean points, ecopoints, recovery sites, waste parks, etc.) where citizens and small businesses can drop off as many waste fractions as possible for separate collection.

Elements of best practice for civic amenity sites include the following:

- Presence of at least a civic amenity site in the local authority or regular periodical presence of a mobile site.
- Separate collection of as many fractions as possible and the possibility to drop off any household waste.
- Training of the staff of the civic amenity sites to maximise recycling, recovery and appropriate safe disposal.
- Watertight paved area and collection of run-off water for appropriate treatment.
- Proximity of the sites to citizens (e.g. accessible without a car by a large share of the population), also thanks to mobile/temporary collection sites.
- Long opening hours to enhance convenience for citizens. These may change across seasons (especially for green cuttings).

Applicability

The concept of collection centres is broadly applicable. The ultimate recyclability of the waste streams collected also depends on the availability of downstream markets.

Associated environmental performance indicators and benchmarks of excellence

Environmental performance indicators	Benchmarks of excellence
(i37) Number of civic amenity sites per 100 000 residents. (i38) Number of different fractions collected at the civic amenity sites. (i32) Availability of product/material exchange areas aimed at fostering reuse in civic amenity sites (y/n). (i39) Easy accessibility of civic amenity sites, e.g. without a car (y/n).	(b14) For municipalities with at least 1 000 residents, there is at least one civic amenity site in their territory or regular periodical presence of a mobile site. (b15) At the civic amenity sites, at least 20 different waste fractions are collected. (b16) In civic amenity sites, product/material exchange areas aimed at fostering reuse are available.

3.2.13. Logistic optimisation for waste collection

It is BEMP to optimise the logistics of waste collection by:

- installing where appropriate an alternative collection system to road transport, such as a pneumatic system in urban areas;
- using Computerised Vehicle Routing and Scheduling (CVRS) technology to optimise collection rounds;
- exploring collaboration opportunities with neighbouring waste management organisations;
- benchmarking fuel/energy consumption and/or CO_2 emissions;
- incorporating one or more environmental metrics, such as cumulative energy demand (CED) and/or CO_2 emissions, in network design and route optimisation algorithms;
- installing telematics equipment into collection vehicles for real-time route optimisation based on GPS and training drivers in eco-driving techniques.

Applicability

All organisations involved in waste collection can implement some degree of logistics optimisation (e.g. planning the location of waste bins). However, the actions are limited in some cases by existing organisational structures (e.g. on-going contracts for outsourced waste collection services).

In terms of collection strategy optimisation, logistics optimisation is secondary to optimising recycling.

Pneumatic waste collection systems are more suitable for densely populated areas and are easier to install in new developments than in existing urban areas.

Associated environmental performance indicators and benchmarks of excellence

Environmental performance indicators	**Benchmarks of excellence**
(i40) Fuel consumption per tonne of waste collected[16](litres/t). (i41) Greenhouse Gas (GHG) emissions per tonne of waste and km travelled (kg CO_2e/tkm).	-

3.2.14. Low-emission vehicles

It is BEMP to improve the fuel consumption and emissions of waste collection vehicles. Priority technology options include:

- stop/start and idle shut-off;
- low rolling resistance tyres;
- hybrid vehicles;
- dedicated natural gas/biomethane vehicles or dual-fuel vehicles (diesel/gas);
- electrically powered vehicles.

Applicability

[16] Depending on the waste collection system in place (e.g. vehicles and/or pneumatic collection, type of vehicles) and the data available, more useful alternatives to this indicator can be: primary energy consumption per tonne of waste collected, cumulative energy demand per tonne of waste collected, GHG emissions per tonne of waste collected.

This BEMP is broadly applicable. The presence of filling or recharging stations is less of an issue for refuse collection than other types of transport because vehicles are usually operated over a limited distance and the fleet is run from a centralised waste depot where refuelling can take place.

Compressed natural gas (CNG) is available in all EU Member States. Biomethane may not be available in many regions, but wet organic waste (e.g. food waste) can be used to produce biogas that can be upgraded to transport biomethane.

Associated environmental performance indicators and benchmarks of excellence

Environmental performance indicators	Benchmarks of excellence
(i42) Average fuel consumption of the waste collection vehicles (litres/100 km). (i43) Share of vehicles that are Euro 6 in the total waste collection vehicle fleet (%). (i44) Share of waste collection vehicles that are hybrid, electric, natural-gas- or biogas-powered (%).	(b17) All new waste collection vehicles purchased or leased by the waste management organisation are Euro 6 and are fuelled by either compressed natural gas or biogas, or are hybrid or electric.

BEMPs for extended producer responsibility schemes

3.2.15. Best use of incentives by producer responsibility organisations

It is BEMP for producer responsibility organisations (PROs) to enhance the performance of their extended producer responsibility (EPR) scheme by setting up incentives (going beyond legal requirements) that drive increased separate collection, reuse and recycling rates for the waste collected under the EPR. Actions that PROs can implement include:

- motivating citizens to source separate waste more and better through innovative communication actions, such as competitions among territories;
- close cooperation (financial, technical and/or logistic) with public authorities at regional/local level;
- cooperation with social economy actors for the collection and reuse of products;
- incentivising producers to design more sustainable products (e.g. via "fee modulation");
- benchmarking environmental achievements of different areas covered by the EPR scheme, e.g. at the level of the territories of public authorities at a regional/local level.

Applicability

The actual leverage that a PRO has on the EPR depends on the national setup and legal allocation of roles and responsibilities. For the application of some incentives, proper allocation of finances is needed. For this, the governance structure of the PRO may play a role (owned by producers or not, for or not for profit, etc.).

Associated environmental performance indicators and benchmarks of excellence

Environmental performance indicators	Benchmarks of excellence
(i45) Recycling rate (% of waste that is actually recycled or sent for recycling out of the total waste	-

covered by the EPR scheme). (i46) Preparation for reuse rate (% of waste that is delivered as input to a centre for preparation for reuse out of the total waste covered by the EPR scheme). (i47) (applicable at the local level for a specific local area where the EPR scheme is in place) Share of EPR-covered products found in residual waste based on composition analysis (% of the total quantity of mixed waste). (i48) (applicable for a specific national, regional or local area where an EPR scheme for packaging waste is in place) Share of EPR-covered packaging that is targeted by the selective separate collection system (% of the total quantity of EPR-covered packaging put on the market).	

BEMPs for waste treatment

3.2.16. Sorting of co-mingled light packaging waste to maximise recycling yields for high-quality output

When light packaging waste (i.e. packaging made of plastics, composites, aluminium and steel, sometimes also including fibres (paper and cardboard)) is collected together (co-mingled), it is BEMP to implement advanced sorting of the co-mingled packaging waste in materials recovery facilities (MRF).

A typical state-of-the-art plant has five main technical sections:

- Feeding and preconditioning: this includes opening bags and feeding a constant flow of input material.
- Pre-sorting: this involves removing unsuitable items.
- Sorting: this includes several steps, e.g. separating fibre from containers; sorting fibre; sorting metal containers by using magnets, eddy currents or X-ray; first sorting of plastic containers by polymer (e.g. separation of PET bottles from other plastic containers).
- Refining: this consists of additional sorting steps, such as further sorting of polymers by type (e.g. HDPE, PP) and colour in order for the material output quality to meet market requirements. Quality control is performed by automatic or manual sorting.
- Product handling: this section consists of the baling processes and product storage as bales, loose material or in containers; product handling can also include loading operations for further downstream processes.

As MRFs tend to receive and sort materials from different local collection schemes, with varying compositions, a state-of-the-art MRF must have the flexibility to efficiently accommodate these variations.

Applicability

In principle, there are no barriers to building and operating a packaging waste sorting plant. However, careful planning (especially considering the collection schemes in place, the plant

capacity and the availability of markets for the sorted materials) is required as part of an integrated waste management concept. An important factor that needs to be determined is the optimal plant capacity. Finally, the impurity rates of co-mingled light packaging waste delivered to the plant affect its operations, performance (e.g. plant sorting rate) and economics (e.g. processing costs, revenues from recyclable fractions).

Associated environmental performance indicators and benchmarks of excellence

Environmental performance indicators	**Benchmarks of excellence**
(i49) Plant sorting rate (weight %), calculated as the annual quantity of materials sent for recycling divided by the annual quantity of co-mingled packaging waste processed[17]. (i50) Energy efficiency (kJ/t), calculated as the annual total energy consumption of the plant divided by the quantity of co-mingled packaging waste processed. (i51) GHG emissions (t CO_2e/t), calculated as the annual total CO_2 equivalent emissions of the plant (Scope 1 and 2) divided by the quantity of co-mingled packaging waste processed.	(b18) Material recovery facilities sorting co-mingled light packaging waste have a plant sorting rate of at least 88 %.

3.2.17. Processing of mixed plastic packaging waste to maximise recycling yields for high-quality output

It is BEMP to process separately collected mixed plastic packaging waste into individual material streams that can be transformed into valuable high-quality secondary raw materials and recycled products. The process encompasses the following steps:

- sorting flexible plastic packaging waste from the rigid items (film sorting) by using film grabbers, air drum or ballistic separators followed by a manual quality assurance step;
- sorting plastic bottles and other rigid items by polymer and colour with optical sorting systems;
- reducing sorted film and residual rigid items (as separate flows) in flakes by using granulators;
- cleaning flaked plastic packaging using friction cleaning (dry or wet grinding systems);
- separating and washing flaked plastics packaging by polymer and colour by using optical sorting systems or density separation technologies;
- extruding flaked material into pellets.

Applicability

Good waste collection systems and the good quality of the collected materials need to be assured in order for the recycled output to be suitable for the market. Current market trends towards more complex multi-layer and multi-material plastic products also make mixed

[17] This indicator can be calculated for the overall co-mingled packaging waste as well as by individual output stream, based on composition analysis of the co-mingled packaging waste processed

plastics sorting and reprocessing much more difficult. As with the previous BEMP, there are no general barriers to building and operating such a plant. However, careful planning and determination of the optimal plant capacity are important.

Associated environmental performance indicators and benchmarks of excellence

Environmental performance indicators	Benchmarks of excellence
(i52) Plant processing rate (weight %), calculated as the annual quantity of materials sent for recycling divided by the annual quantity of mixed plastic packaging waste processed[18]. (i50) Energy efficiency (kJ/t), calculated as the annual total energy consumption of the plant divided by the quantity of mixed plastic packaging waste processed. (i51) GHG emissions (t CO_2e/t), calculated as the annual total CO_2 equivalent emissions of the plant (scope 1 and 2) divided by the quantity of mixed plastic packaging waste processed. (i53) Water use (m^3/t), calculated as the annual total water used on site divided by the quantity of mixed plastic packaging waste processed.	(b19) Plastic recovery facilities processing mixed plastic packaging waste have a plant processing rate of at least 60 %.

3.2.18. Treatment of mattresses for improved recycling of materials

It is BEMP to sanitise and disassemble end-of-life mattresses, separating and sorting the different materials by type.

Five main technical operations can be identified in a best performing end-of-life mattress treatment facility:

- feeding and storage: reception (unloading) and dry storage to avoid contamination, sorting by type;
- sanitising: applying chemical or heat treatments for sterilisation;
- filleting: cutting the mattress' outer fabric cover and the binding flanges;
- disassemble and sorting: separating and sorting the different materials by type;
- handling materials: baling processes, product storage as bales, loose material (sorting residues) or in containers (metals), before delivery to downstream processes (e.g. recycling of metals).

The disassembling and sorting operations can be carried out mechanically or (more commonly) manually.

Applicability

There are no main technical barriers to the applicability of this BEMP. The simplicity of the treatment process does not require significant investments, even for the most automated processes.

[18] This indicator can be calculated for the overall mixed plastic packaging waste as well as by individual output stream, based on composition analysis of the mixed plastic packaging waste processed

The most important obstacles for mattress recycling are identified as follows:

- economic factors, notably the low cost of landfilling and the low quality of the materials arising from mattresses, linked to the need to store end-of-life mattresses in a clean and dry place and current mattress designs preventing easy disassembly;
- the low treatment capacity of the facilities, limited by the end-of-life mattress flow collectable in the area surrounding the plant at affordable transport costs.

Associated environmental performance indicators and benchmarks of excellence

Environmental performance indicators	**Benchmarks of excellence**
(i54) Plant sorting rate (weight %), calculated as the annual quantity of materials sent for recycling divided by the annual quantity of waste mattresses processed. (i50) Energy efficiency (kJ/t), calculated as the annual total energy consumption of the plant divided by the quantity of waste mattresses processed. (i51) GHG emissions (t CO_2e/t), calculated as the annual total CO_2 equivalent emissions of the plant (scope 1 and 2) divided by the quantity of waste mattresses processed.	(b20) Facilities treating waste mattresses have a plant sorting rate of at least 91 %.

3.2.19. Treatment of absorbent hygiene products for improved recycling of materials

It is BEMP to treat separately collected absorbent hygiene products (AHP) waste for recycling.

The core process is a thermal treatment in an autoclave, an horizontal cylindrical vessel where the AHP waste is sanitized and opened. The output solid stream is then shredded and separated through a mechanical process into the two AHP components: polypropylene and polyethylene plastics and cellulose fibres, which can be sent for recycling.

Applicability

This BEMP is broadly applicable as no particular geographical or technical barriers exist. However, some specific conditions can influence the technical and economic viability of this treatment solution:

- implementation of a selective collection scheme for AHP waste as a prerequisite;
- minimum plant treatment capacity of 8 000 t/year;
- transport distance from collection areas to the plant and costs for landfilling and incineration;
- population density in the collection area;
- criteria and rules for recognising the end-of-waste and local market for recovered materials (plastic and cellulose).

Associated environmental performance indicators and benchmarks of excellence

Environmental performance indicators	**Benchmarks of excellence**

(i55) Plant sorting rate (weight %), calculated as the annual quantity of materials sent for recycling divided by the annual quantity of AHP waste processed. (i50) Energy efficiency (kJ/t), calculated as the annual total energy consumption of the plant divided by the quantity of AHP waste processed. (i51) GHG emissions (t CO_2e/t), calculated as the annual total CO_2 equivalent emissions of the plant (scope 1 and 2) divided by the quantity of AHP waste processed. (i53) Water use (m^3/t), calculated as annual total water used on-site divided by the quantity of AHP waste processed.	(b21) Facilities treating absorbent hygiene products waste have a plant sorting rate of at least 90 %.

3.3. Common environmental performance indicators for municipal solid waste

In addition to the indicators set in the individual BEMPs on MSW, this section of the document defines environmental performance indicators that can be used to assess the performance of municipal solid waste management systems.

Each indicator presented in this section only assesses certain elements of the performance of the MSW management system. For a comprehensive understanding, the different indicators should be analysed together.

Indicators for the overall municipal solid waste management system

3.3.1. MSW generation

This indicator measures the annual amount of total MSW[19] generated per resident[20]. This indicator is useful to monitor the overall waste generation trends as well as the results of any effort to promote waste prevention.

Environmental performance indicator	Benchmark of excellence
(i56) MSW generation (kg/capita/year).	(b22) The annual generation of MSW in the territory administered or managed (collected by all the different waste collection systems available in the area) is: - lower than 75% of the national average of municipal waste generation[21], using the national definition of municipal waste of their own country; or - lower than 360 kg/capita, if calculated only for the

[19] In the calculation of this indicator and the ones in section 3.3.2, 3.3.3, 3.3.4 and 3.3.7, the annual amount of total municipal solid waste generated can be substituted by the annual amount of total household waste generated, if data just for household waste is known.

[20] In the calculation of this indicator and the ones in section 3.3.2, 3.3.3, 3.3.4 and 3.3.7, the number of residents can be substituted by the population equivalent where tourist presence is relevant. The population equivalent is calculated based on the presence of tourists over the period considered for the calculation.

[21] As reported by national authorities or by the statistical office of the European Union (Eurostat)

	following waste fractions[22]: (i) organic/biowaste (e.g. green cuttings, food, kitchen waste), (ii) co-mingled packaging, (iii) paper and cardboard, (iv) glass, (v) plastics, (vi) metals, (vii) bulky, (viii) waste electrical and electronic equipment (WEEE) and (ix) mixed waste.

This indicator takes into account all different MSW streams collected separately by all the different collection systems available in the territory considered (e.g. door-to-door, civic amenity sites, street containers). In areas where there is no detailed waste monitoring or where a part of the waste generated is not collected by the formal municipal waste collection system, figures on MSW generation could underestimate the real situation. Moreover, this indicator is affected by external factors that are not related to waste management in the relevant local area, such as rural/urban location, gross domestic product and consumption patterns, weather and significant presence of tourists/daily commuters.

3.3.2. Amount of mixed MSW collected

This indicator measures the annual amount of mixed MSW collected per resident. This indicator is useful to monitor the MSW separate collection system and its capacity to drive MSW into the separately collected fractions sent for recycling. In fact, mixed waste, generally, undergoes less preferred treatment operations, according to the waste hierarchy, compared to separately collected fractions.

Environmental performance indicator	**Benchmark of excellence**
(i57) Amount of mixed waste collected (kg/capita/year).	-

This indicator takes into account the waste collected as non-source separated mixed waste. It is affected not only by how much waste that should have been source separated has been delivered as mixed waste, but also by what are the waste fractions for which no separate collection system is in place. Therefore, the amount of mixed MSW vary significantly depending on the types of waste collection systems established, e.g. if biowaste is collected

[22] The following fractions have been selected because they are commonly monitored in the EU by local waste authorities and waste management companies and they are generally the most relevant fractions (by weight) in MSW.

separately or not, which type of biowaste is admitted in the separately collected fraction. Moreover, this indicator is affected by external factors that are not related to waste management in the relevant local area, such as rural/urban location, gross domestic product and consumption patterns, weather and significant presence of tourists/daily commuters.

3.3.3. MSW sent to energy recovery and/or disposal

This indicator measures the annual amount of MSW per resident that is treated by either incineration with energy recovery and/or disposal operations, such as landfilling or incineration without energy recovery. This indicator is useful to monitor the amount of MSW treated with less favourable options, compared to recycling, according to the waste hierarchy (i.e. energy recovery and/or disposal).

Environmental performance indicator	Benchmarks of excellence
(i58) Waste sent to energy recovery and/or disposal (kg/capita/year).	(b23) The annual amount of collected mixed MSW sent to energy recovery and/or disposal is: - lower than 15% of the national average of municipal waste generation[23]; or - lower than 70 kg/capita.

This indicator takes into account all flows of MSW, sent directly, as mixed waste, or after pre-treatment (e.g. Mechanical Biological Treatment), to energy recovery and/or disposal. This indicator includes also the flow of rejects from the sorting/recycling of the separately collected fractions that are not recycled but sent to energy recovery and/or disposal. In case information on the flow of rejects from the sorting/recycling of the separately collected fractions is not available, this indicator can be calculated partially, reporting only the amount of mixed waste sent to energy recovery and/or disposal. In such case, the local waste authority (or waste management company) clearly states the elements that are included and those that are not included in the calculation[24].

Finally, this indicator is affected by external factors that are not related to waste management in the relevant local area, such as rural/urban location, gross domestic product and consumption patterns, weather and significant presence of tourists/daily commuters.

3.3.4. MSW sent to disposal

This indicator measures the annual amount of MSW per resident that is sent to disposal, such as incineration without energy recovery or landfill. This indicator is useful to monitor if the waste management of MSW has moved up the waste hierarchy: in fact, if waste sent to disposal decreases, more waste has either been prevented, prepared for reuse, recycled or sent to energy recovery.

Environmental performance indicator	Benchmark of excellence

[23] As reported by National Authorities or by the statistical office of the European Union (Eurostat)

[24] For instance, benchmark b23 only refers to the amount of MSW collected as mixed waste and sent to energy recovery and/or disposal

(i59) Waste sent to disposal (kg/capita/year).	(b24) The annual amount of MSW sent to disposal is: - lower than 2% of the national average of municipal waste generation; or - lower than 10 kg/capita.

This indicator takes into account all flows of MSW, sent directly, as mixed waste, or after pre-treatment (e.g. Mechanical Biological Treatment), to disposal. This indicator includes also the flow of rejects from the sorting/recycling of the separately collected fractions that are not recycled but sent to disposal. In case information on the flow of rejects from the sorting/recycling of the separately collected fractions is not available, this indicator can be calculated partially, reporting only the amount of mixed waste sent to disposal. In such case, the local waste authority (or waste management company) clearly states the elements that are included and those that are not included in the calculation.

Finally, this indicator is affected by external factors that are not related to waste management in the relevant local area, such as rural/urban location, gross domestic product and consumption patterns, weather and significant presence of tourists/daily commuters.

Waste stream specific indicators

3.3.5. Capture rate of a specific waste stream

This indicator measures the share of the estimated generation of a specific waste fraction that is collected separately (e.g. plastic, metal, paper and cardboard, glass and co-mingled packaging). This indicator is useful to monitor how efficient is a separate waste collection system in intercepting the recyclable fractions.

Environmental performance indicator	Benchmarks of excellence
(i60) Capture rate of a specific waste stream (%).	(b25) The capture rate for waste glass separately collected as single fraction (i.e. not in a co-mingled collection system) is higher than 90 %. (b26) The capture rate for waste paper and cardboard separately collected as single fraction (i.e. not in a co-mingled collection system) is higher than 85 %. (b27) The capture rate for waste metals separately collected as single fraction (i.e. not in a co-mingled collection system) is higher than 75 %. (b28) The capture rate for co-mingled waste packaging is higher than 65 %.

This indicator is calculated dividing the total amount collected of a separately collected waste stream by the total generation of the waste that was targeted by that separate collection, calculated thanks to the composition analysis of the mixed waste[25].

[25] As illustrative example, the capture rate for the separately collected fraction of waste glass is calculated as:

This indicator can be affected by the presence of a deposit refund scheme for some types of waste (e.g. plastic bottles) for which data at local level cannot be disaggregated. In this case, the actual capture rate would be higher than the one calculated, because the amounts of waste collected by the deposit refund scheme do not appear in the local waste statistics of separately collected waste fractions.

3.3.6. Impurity rate of a specific waste stream

This indicator measures the amount of non-target materials in a specific separately collected waste stream. This indicator is useful to monitor how effective the separate waste collection is, by assessing the amount of misthrows in the recyclable fractions.

Environmental performance indicator	Benchmark of excellence
(i61) Impurity rate of a specific waste stream (%).	-

This indicator takes into account the amount of misthrows (resulting from wrong waste source separation and assessed by composition analysis of separately collected waste fractions), contained in the separately collected recyclables. The amount of impurities in separately collected recyclable fractions varies also according to the type of separate collection system in place, e.g. plastic bottles collected through deposit refund schemes tend to have very low impurities, while these are considerably higher for co-mingled light packaging.

3.3.7. Biowaste in mixed waste

This indicator measures the annual amount of biowaste included in mixed waste per resident. This indicator is useful to monitor how much biowaste is not correctly sorted at the source and captured by a separate biowaste collection system or used by residents in home/community composting.

Environmental performance indicator	Benchmark of excellence
(i62) Biowaste in mixed waste (kg/capita/year).	(b29) The annual amount of biowaste in mixed waste is lower than 10 kg/capita.

The amount of biowaste in mixed waste is calculated from the composition analysis of mixed waste. The amount of biowaste in mixed waste varies also according to the type of biowaste separate collection system in place, e.g. which type of biowaste is admitted in the separately collected fraction, whether home/community composting is available to residents.

$$\textit{Capture rate for glass} = \frac{\textit{kg of separately collected glass}}{\textit{kg of total glass waste generation}}$$

Where:
total glass waste generation=kg separately collected glass+ kg of glass in mixed waste
kg of glass in mixed waste=kg of total mixed waste% of glass in mixed waste*
% of glass in mixed waste is calculated from the composition analysis of the mixed waste.

3.4. BEMPs for construction and demolition waste

BEMPs presented in this section deal with the management of construction and demolition waste (CDW).

3.4.1. Integrated construction and demolition waste plans

It is BEMP for local authorities to develop and implement integrated CDW plans that:

- Involve stakeholders from the local construction industry, representatives of residents, local business associations, and relevant public actors;
- Prioritise waste prevention in construction projects through instruments oriented to the industry and public administration, such as a demolition code of practice and promotion of appropriate green public procurement provisions;
- Establish minimum requirements for waste sorting and management in construction sites of a certain size, e.g. requirements for a site waste management plan (SWMP), or required fractions to be separated;
- Identify and quantify future flows of waste, ensure the local urban development plan allocates sufficient areas for collection and treatment of CDW;
- Calculate the total costs and the impact of implementation;
- Establish more ambitious objectives than the EU or national CDW recycling targets as well as appropriate monitoring and enforcement mechanisms;
- Include measures to avoid illegal dumping and provide clear guidance (e.g. for SMEs, residents and producers of very small quantities of CDW) on correct CDW management practices.

Applicability

The formulation and implementation of local waste management plans for CDW is a commonly used instrument by regions and large municipalities.

Associated environmental performance indicators and benchmarks of excellence

Environmental performance indicators	Benchmarks of excellence
(i63) Share of total collected CDW that is correctly segregated and managed towards reuse, recycling or recovery (%). (i64) Provision for pre-demolition audits aimed at reuse (y/n).	(b30) An integrated CDW management plan is implemented with a target CDW recycling rate in 2020 of at least 80 % and provisions for monitoring and enforcement mechanisms.

3.4.2. Avoidance of polychlorinated biphenyl (PCB) contamination of construction and demolition waste

In the case of demolition or deconstruction as well as refurbishment of buildings, bridges and structures from the 1950s, 1960s and 1970s, there is a risk that CDW materials may be contaminated with polychlorinated biphenyls (PCBs) which prevent its recycling.

It is BEMP for waste authorities to introduce provisions in the CDW plan (see Section 3.4.1) that include:

- pre-auditing and mapping of the building, bridge or structure to be demolished, deconstructed or refurbished in order to identify any PCB-containing material (e.g. sealants);

- separate removal of the PCB-containing materials from the rest of the CDW;
- separate collection and appropriate disposal of the removed PCB-containing materials.

Applicability

This BEMP is broadly applicable for waste authorities responsible for CDW. Small works, producing less than 1 tonne of CDW or affecting less than 10 m^2 of the surface area of the building, can be excluded from the provisions on identifying and separating PCBs in the CDW plan.

Associated environmental performance indicators and benchmarks of excellence

Environmental performance indicators	Benchmarks of excellence
(i65) Inclusion of provisions for the mapping and separate removal and collection of PCB-containing materials in the CDW plan (y/n).	-

3.4.3. Local schemes for proper management of waste asbestos removed by residents

It is BEMP for waste authorities and waste management companies to ensure the proper management of the small quantities of asbestos-containing construction and demolition waste removed from private buildings by residents without the intervention of a specialised company. To do so, they can provide:

- clear instructions on the condition required (e.g. no risk of powder dispersion) in order for the asbestos material to be removed by the private owner and on how to prepare the construction site for asbestos removal;
- guidance on the rules that the private owner has to follow in order to ensure the health and safety of nearby residents during removal;
- a list of certified companies or information on collection points for asbestos-containing waste;
- sealable double-coated bags (for collection/disposal) available to residents undertaking the removal;
- either proper collection points (e.g. at civic amenity sites) or free home collection services.

Frontrunner local authorities go one step further and set a strategy for assessing the presence of asbestos in their territory, helping private owners plan proper action and keeping track of all asbestos in buildings even before it is removed.

Applicability

This BEMP is applicable only to certain cement-bonded asbestos (such as asbestos cement roofs, wall and ceiling cladding; asbestos down pipes and gutters, etc.) in good condition (no risk of powder dispersion) and in case of very small amounts. Cement-bonded asbestos at risk of powder dispersion, as well as other asbestos applications, especially those of lower density (or crumbly/flaky) such as insulating boards, lagging, or sprayed asbestos, are always required to be removed and disposed of by a specialist contractor.

Associated environmental performance indicators and benchmarks of excellence

Environmental performance indicators	Benchmarks of excellence

(i66) Number of collection points for asbestos waste per 100 000 residents. (i67) Total amount of asbestos collected through the scheme, expressed in weight (tonnes) or surface area (m^2). (i68) Number of sealable bags for collection/disposal of asbestos used by residents.	(b31) There is at least one collection point per 100 000 residents or free home collection for waste asbestos removed by residents.

3.4.4. Processing of waste plasterboard to foster recycling

It is BEMP for waste management companies processing waste plasterboard to recover gypsum. Processing of waste plasterboard for the recovery of gypsum usually consists of the following steps (for well-segregated waste plasterboard): reception, visual check and classification, separation of unsuitable materials (e.g. metals), (if required) grouping of the panels according to size, paper and gypsum separation (through a grinding and sieving process) and sieving of gypsum. Recovered gypsum can then be used (usually up to 25 % of the total content) for the production of new plasterboard.

Applicability

There are no technical barriers to the applicability of this BEMP. However, there are significant economic barriers: the recyclability of the waste plasterboard depends on the level of segregation at the site where it is generated[26] and poor segregation leads to cost-inefficient situations. Moreover, transport costs of waste plasterboard over long distances may also affect the economic viability.

Associated environmental performance indicators and benchmarks of excellence

Environmental performance indicators	Benchmarks of excellence
(i69) Efficiency of material recovery at the waste plasterboard processing plant (%).	-

3.4.5. Processing CDW for the production of recycled aggregates

It is BEMP for waste management companies treating CDW to recover concrete from CDW as recycled concrete aggregate (RCA). This processing takes place in plants which usually consist of the following steps (for well-segregated CDW): reception, characterisation and identification of incoming CDW, (manual) preselection, screening of large materials, magnetic separation, screening for fine materials, crushing, screening and secondary crushing.

[26] In some cases, segregation at the construction site may not be possible due to space constraints. In such situations, the waste plasterboard can be pretreated and segregated at different locations before being processed.

The recyclability of the inert elements of CDW depends on the level of segregation at the site where they are generated[27] and poor segregation leads to the processing of CDW being cost-inefficient.

Applicability

There is no specific limitation to the applicability of this BEMP as long as the CDW is well segregated in the different fractions at the construction sites.

Associated environmental performance indicators and benchmarks of excellence

Environmental performance indicators	Benchmarks of excellence
(i70) Efficiency of material recovery at the CDW processing plant (%). (i71) Annual amount of RCA marketed (t/year).	-

3.5. BEMPs for healthcare waste

BEMPs presented in this section deal with the management of healthcare waste (HCW).

BEMPs for healthcare waste segregation

3.5.1. Encouragement of healthcare waste segregation at healthcare facilities

There is a significant potential to reduce the environmental impact of healthcare waste (HCW) management, in particular by targeting better prevention, segregation and treatment of non-hazardous waste, with due consideration of safety. It is BEMP for HCW management companies to:

- Organise waste audits at healthcare facilities in order to improve the knowledge of the various waste fractions and the current waste management practices.
- Help healthcare facilities with the definition of their waste management system by establishing clear guidelines for the categories of waste to be sorted.
- Organise training sessions to raise awareness among the healthcare facilities' staff and explain the rules for waste segregation (training sessions should be tailored to the different roles of staff within the healthcare facility and give special attention to addressing non-compliances identified during audits or during the handling of HCW by the HCW management company).
- Provide information material (posters, indications on containers, etc.) to help the healthcare facility's staff with instructions.
- Monitor the results and impacts of the action by defining a set of key performance indicators (including risk management and financial savings).

[27] In some cases, segregation at the construction site may not be possible due to space constraints. In such situations, the CDW can be pretreated and segregated at different locations before being processed for the production of recycled aggregates.

- Implement innovative technical solutions reducing the general environmental impact of the waste management system, e.g. on re-use of containers for the collection of HCW.

Better segregation of waste produced in healthcare facilities enables more recycling because it avoids that non-hazardous waste, including recyclables (e.g. printed paper, plastic bottles), is incorrectly put together with hazardous waste.

Applicability

There is no specific limitation to the applicability of this BEMP by HCW management companies. However, the commitment of healthcare facilities towards an improved HCW management plays a key role for the type of measures and success of the actions implemented.

Associated environmental performance indicators and benchmarks of excellence

Environmental performance indicators	Benchmarks of excellence
(i72) Share of staff members of the client healthcare facility having undergone a training session about waste in the last two years (%). (i73) Share of correct answers given by staff members of the client healthcare facility in post-training evaluation surveys about handling of waste in the healthcare facility (%). (i74) Collection rates per waste fraction, per bed or per patient, according to the specific fractions collected in each healthcare facility (kg/patient/day).	-

3.5.2. Healthcare waste collection for households

This BEMP focuses on collection systems implemented by local authorities and/or waste management companies to collect hazardous HCW generated by households, specifically sharps and needles generated from treatments performed at home.

It is BEMP to adopt a separate HCW collection scheme for households that ensures safe and environmentally friendly HCW collection and management by:

- assessing the quantities of HCW arising;
- providing appropriate boxes for collection;
- selecting collection methods and frequency of collection according to local conditions;
- involving stakeholders, typically: pharmacies and other healthcare actors (such as medical doctors and nurses), patients performing home treatment and the medical industry;
- putting in place controls and corrective actions for the HCW collection system.

Applicability

The BEMP is applicable to all local authorities and/or waste management companies.

Associated environmental performance indicators and benchmarks of excellence

Environmental performance indicators	Benchmarks of excellence
(i75) Number of collection points for HCW generated by households per 10 000 residents, by type (civic amenity sites, pharmacies, street containers). (i76) Number of individual boxes for HCW generated by households distributed via collection points or on request. (i77) Quantity of HCW generated by households collected (kg/capita/year). (i78) Share of HCW (e.g. sharps) in mixed household waste (%).	-

BEMPs for the treatment of healthcare waste

3.5.3. Alternative treatments for healthcare waste

High-temperature incineration is the most common treatment method for healthcare waste (HCW) because of safety concerns; however, it has significant environmental impacts such as high energy use, natural resources depletion and emissions. There are alternative treatments that can also guarantee safety levels for waste streams of concern (e.g. infectious waste, anatomical waste, sharps and pharmaceutical waste) and they can achieve a better environmental performance than high-temperature incineration, e.g. thanks to reduced energy use or better resource efficiency (increasing the rate of recycling from HCW).

When using alternative treatments for HCW, it is BEMP to meet the following criteria:

- Autoclaving:
  - optimal segregation at source;
  - homogeneous particle size at the inlet;
  - steam-based sterilisation with simultaneous/post-shredding;
  - drying step after treatment;
  - output separated per material stream when possible and sent for recycling;
  - incineration with energy recovery of the suitable non-recyclable outputs.
- Microwaving:
  - optimal segregation at source;
  - water addition at the inlet;
  - drying step after treatment;
  - output separated per material stream when possible and sent for recycling;
  - incineration with energy recovery of the suitable non-recyclable outputs.

- Chemical treatments:
  - optimal segregation at source;
  - output not considered hazardous waste or treated for optimum recovery;
  - sterilisation agent is recyclable within the process;
  - output separated per material stream when possible and sent for recycling;
  - incineration with energy recovery of the suitable non-recyclable outputs.

Applicability

High-temperature incineration is still the most common treatment for HCW. Four main factors affect the applicability of alternative treatments: source segregation, proving the safety of alternative treatments in treating certain fractions of segregated waste, the optimum operating capacity for incineration and the national legal framework for HCW treatment.

Associated environmental performance indicators and benchmarks of excellence

Environmental performance indicators	**Benchmarks of excellence**
(i79) Share of HCW managed by the HCW management company processed by alternative treatments (%). (i80) Amount of HCW processed by alternative treatments (kg HCW per hour, day or cycle). (i81) Water consumption per kg of waste processed by alternative treatments (litres/kg).	-

4. RECOMMENDED SECTOR-SPECIFIC KEY ENVIRONMENTAL PERFORMANCE INDICATORS

The following table lists a selection of key environmental performance indicators for the waste management sector, together with the related benchmarks and reference to the relevant BEMPs. These are a subset of all the indicators mentioned in section 3.

Table 4.1: Key environmental performance indicators and benchmarks of excellence for the waste management sector

Indicator	Common units	Main target group	Short description	Recommended minimum level of monitoring	Related EMAS core indicator[28]	Benchmark of excellence	Related BEMP [29]
Cross-cutting BEMPs							
Overall targets for the improvement of the waste management system are in place	y/n	Waste authorities and waste management companies	Overall targets for the improvement of the waste management system are in place (e.g. based on the indicators defined in this document).	Territory administered or organisation	Waste Material efficiency	An integrated waste management strategy that includes long-term (i.e. 10–20 years) and short-term (i.e. 1–5 years) overall targets for the improvement of the performance of the waste management system is in place and regularly reviewed (at least every 3 years).	3.1.1
Systematic application of life-cycle thinking, and, where necessary, undertaking of life-cycle assessments, throughout waste management strategy design and	y/n	Waste authorities and waste management companies	Life-cycle thinking is systematically applied, and, where necessary, life-cycle assessment is undertaken, throughout waste management strategy design and implementation.	Territory administered or organisation	Waste Material efficiency Emissions	The waste management strategy is designed and implemented on the basis of systematic application of life-cycle thinking and, when needed, ad-hoc life-cycle assessment studies.	3.1.2

[28] EMAS core indicators are listed in Annex IV to Regulation (EC) No 1221/2009 (Section C.2)

[29] The numbers refer to the sections in this document where the relevant related BEMP is described or the indicator is presented.

Indicator	Common units	Main target group	Short description	Recommended minimum level of monitoring	Related EMAS core indicator[28]	Benchmark of excellence	Related BEMP [29]
implementation							
Use of economic instruments at local level to stimulate good behaviour	y/n	Waste authorities and waste management companies	Economic instruments (e.g. taxes and tax modulation, product levies, waste pricing, extended producer responsibility schemes and deposit-refund schemes) are used at local level to stimulate good behaviour in waste prevention and management.	Territory administered or organisation	Waste Material efficiency Emissions	- Economic instruments set at local level in the form of taxes and tax modulation, product levies, waste pricing, extended producer responsibility schemes and deposit-refund schemes are systematically implemented as a mean to achieve the objectives set in the local waste management strategy - For local authorities, a deposit refund scheme for glasses, cups, dishes and cutlery is in place for all festivals and large public events organised in the territory of the local authority.	3.1.3
Relevant state-of-the-art techniques described in the reference documents listed in section 3.1.4 are implemented	y/n	Waste authorities and waste management companies	The state-of-the-art techniques described in the reference documents listed in section 3.1.4 and considered relevant by the organisation are implemented.	Territory administered or organisation	Waste Material efficiency Emissions	N/A	3.1.4
BEMPs for municipal solid waste (MSW)							
Total MSW management	EUR/capita/year	Waste	Annual total cost of MSW	Territory	Waste	N/A	3.2.1

Indicator	Common units	Main target group	Short description	Recommended minimum level of monitoring	Related EMAS core indicator[28]	Benchmark of excellence	Related BEMP [29]
cost per resident per year		authorities and waste management companies	management in the relevant local area, including all waste management phases and activities performed, per resident per year.	administered or organisation			
Frequency of composition analysis of mixed waste	Months Years	Waste authorities and waste management companies	How often a composition analysis of mixed waste (of a representative sample) is carried out (one composition analysis every # months or years).	Territory administered or organisation	Waste Material efficiency	Composition analysis of mixed waste is carried out at least four times a year (during different seasons) every three years or after any substantial change of the waste management system.	3.2.2
A pay-as-you-throw (PAYT) system is in place	y/n	Waste authorities and waste management companies	A pay-as-you-throw (PAYT) system is in place in the relevant local area.	Territory administered or organisation	Waste Material efficiency	A pay-as-you-throw system is in place, according to which at least 40 % of the cost is charged to the users depending on the quantity (kg or m^3) of mixed waste collected, the size of the waste collection bins and/or the number of collection rounds.	3.2.3
Inclusion of waste conferred to civic amenity sites in the PAYT system	y/n	Waste authorities and waste management companies	Waste conferred by the users of the waste management system to civic amenity sites is included in the PAYT system.	Territory administered or organisation	Waste Material efficiency	The PAYT system also includes the waste conferred to civic amenity sites.	3.2.3

Indicator	Common units	Main target group	Short description	Recommended minimum level of monitoring	Related EMAS core indicator[28]	Benchmark of excellence	Related BEMP [29]
Budget spent on awareness-raising per resident per year	EUR/capita/year	Waste authorities and waste management companies	Annual expenditure for awareness-raising activities in the relevant local area divided by the number of residents.	Territory administered or organisation	Waste Material efficiency	Awareness campaigns are systematically implemented for different types of target groups (e.g. pupils, general public, users of civic amenity sites) and the annual budget devoted to awareness-raising activities is at least EUR 5 per resident.	3.2.5
Number of waste advisers per 100 000 residents	number/100 000 residents	Waste authorities and waste management companies	Number of waste advisers per 100 000 residents in the relevant local area.	Territory administered or population served	Waste Material efficiency	A network of waste advisers is in place with at least one waste adviser per 20 000 residents.	3.2.6
Share of population doing home/community compositing or to which community composting is available	%	Waste authorities and waste management companies	Share of population doing home compositing or to which community composting is available out of the total population in the relevant local area.	Territory administered or population served	Waste Material efficiency	All residents have access to either separate collection of biowaste or home and community composting of biowaste.	3.2.7
Establishment of a local waste prevention plan, including long-term and short-term targets and provisions for regular monitoring	y/n	Waste authorities and waste management companies	A local waste prevention plan is established, including long-term and short-term targets and provisions for regular monitoring.	Territory administered or organisation	Waste Material efficiency	Waste prevention has strategic relevance in the waste management strategy, which includes a local waste prevention programme underpinning long-term (i.e. 10–20 years) and short-term (i.e. 1–5	3.2.8

Indicator	Common units	Main target group	Short description	Recommended minimum level of monitoring	Related EMAS core indicator[28]	Benchmark of excellence	Related BEMP [29]
						years) waste prevention targets and including provisions for regular monitoring.	
Number or quantity of end-of-life products collected for re-use and waste items sent for preparation for reuse	Kg/year Number/year	Waste authorities and waste management companies	Annual number or quantity (i.e. weight or volume) of end-of-life products collected for re-use and waste items sent for preparation for reuse.	Territory administered or organisation	Waste Material efficiency	N/A	3.2.9
Annual number of customers of the reuse centres/community repair points	Number/year	Waste authorities and waste management companies	Annual number of customers of the reuse centres and community repair points.	Territory administered or organisation	Waste Material efficiency	N/A	3.2.9
Availability of products/materials exchange areas aimed at fostering reuse in civic amenity sites	y/n	Waste authorities and waste management companies	Availability of products/materials exchange areas, aimed at fostering reuse, in civic amenity sites.	Territory administered or organisation	Waste Material efficiency	In civic amenity sites, products/materials exchange areas aimed at fostering reuse are available.	3.2.9 3.2.12
Participation rate	%	Waste authorities and waste management companies	Share of the population using the waste collection system; data is usually available, based on estimations, surveys, how often the bin for recyclables is left out for collection, etc.	Territory administered or population served	Waste Material efficiency	N/A	3.2.10
Share of the local area covered with a specific	%	Waste authorities and	Share of the local area covered with a specific waste collection system, e.g.	Territory administered or	Waste	Door-to-door waste collection of at least four	3.2.10

Indicator	Common units	Main target group	Short description	Recommended minimum level of monitoring	Related EMAS core indicator[28]	Benchmark of excellence	Related BEMP [29]
waste collection system		waste management companies	% of urban area covered by door-to-door collection of MSW.	organisation	Material efficiency	waste fractions is implemented in the whole territory in which MSW is managed.	
Number of civic amenity sites per 100 000 residents.	Number/100 000 residents	Waste authorities and waste management companies	Number of civic amenity sites in the relevant local area per 100 000 residents.	Territory administered or population served	Waste Material efficiency	N/A	3.2.12
Number of different waste fractions collected at the civic amenity sites	Number	Waste authorities and waste management companies	Number of different waste fractions collected at the civic amenity sites.	Territory administered or organisation	Waste Material efficiency	At the civic amenity sites, at least 20 different waste fractions are collected.	3.2.12
Greenhouse Gas (GHG) emissions per tonne of waste and km travelled	Kg CO_2e/tkm	Waste authorities and waste management companies	Total amount of GHG emissions generated during waste collection over a specific timeframe, divided by the quantity of waste collected and distance covered by waste collection vehicles over the same period.	Territory administered or organisation	Waste Emissions Energy efficiency	N/A	3.2.13
Average fuel consumption of the waste collection vehicles	litres/100 km	Waste authorities and waste management companies	Total fuel used by waste collection vehicles divided by the total distance (in hundreds of km) covered over a specific timeframe.	Organisation	Waste Emissions Energy efficiency	N/A	3.2.14
Share of vehicles that are Euro 6 in the total waste	%	Waste authorities and	Number of vehicles that are Euro 6 in the waste collection vehicle fleet	Organisation	Energy	All new waste collection vehicles purchased or	3.2.14

Indicator	Common units	Main target group	Short description	Recommended minimum level of monitoring	Related EMAS core indicator[28]	Benchmark of excellence	Related BEMP [29]
collection vehicle fleet		waste management companies	divided by the total number of the waste collection vehicles in the fleet.		efficiency Emissions	leased by the waste management organisation are Euro 6 and are fuelled by either compressed natural gas or biogas, or are hybrid or electric.	
Share of EPR-covered products found in residual waste based on composition analysis	%	Producer Responsibility Organisations, Waste authorities and waste management companies	Share of EPR-covered products found in residual waste based on the composition analysis of mixed waste.	Territory administered or relevant local area	Waste Material efficiency	N/A	3.2.15
Plant sorting rate of co-mingled light packaging waste	%	Plant operators	Annual quantity of materials sent for recycling divided by the annual quantity of co-mingled packaging waste processed. This indicator can be calculated for the overall co-mingled packaging waste as well as by individual output stream.	Sorting facility	Waste Material efficiency	Material recovery facilities sorting co-mingled light packaging waste have a plant sorting rate of at least 88 %.	3.2.16

Indicator	Common units	Main target group	Short description	Recommended minimum level of monitoring	Related EMAS core indicator[28]	Benchmark of excellence	Related BEMP [29]
Plant processing rate of mixed plastic packaging waste	%	Plant operators	Annual quantity of materials sent for recycling divided by the annual quantity of mixed plastic packaging waste processed. This indicator can be calculated for the overall mixed plastic packaging waste as well as by individual output plastic stream (e.g. PE, HDPE, PP).	Processing facility	Waste Material efficiency	Plastic recovery facilities processing mixed plastic packaging waste have a plant processing rate of at least 60 %.	3.2.17
Plant sorting rate of waste mattresses	%	Plant operators	Annual quantity of materials sent for recycling divided by the annual quantity of waste mattresses processed.	Sorting facility	Waste Material efficiency	Facilities treating waste mattresses have a plant sorting rate of at least 91 %.	3.2.18
Plant sorting rate for absorbent hygiene products (AHP) waste	%	Plant operators	Annual quantity of materials sent for recycling divided by the annual quantity of AHP waste processed.	Sorting facility	Waste Material efficiency	Facilities treating absorbent hygiene products waste have a plant sorting rate of at least 90 %.	3.2.19
Common environmental performance indicators for municipal solid waste							
MSW generation	kg/capita/year	Waste authorities and waste management companies	Annual amount of total MSW generated divided by the number of resident.	Territory administered or relevant local area	Waste Material efficiency	The annual generation of MSW in the territory administered or managed (collected by all the different waste collection systems available in the area) is:	3.3.1

Indicator	Common units	Main target group	Short description	Recommended minimum level of monitoring	Related EMAS core indicator[28]	Benchmark of excellence	Related BEMP [29]
						- lower than 75 % of the national average of municipal waste generation , using the national definition of municipal waste of their own country; or - lower than 360 kg/capita, if calculated only for the following waste fractions : (i) organic/biowaste (e.g. green cuttings, food, kitchen waste), (ii) co-mingled packaging, (iii) paper and cardboard, (iv) glass, (v) plastics, (vi) metals, (vii) bulky, (viii) waste electrical and electronic equipment (WEEE) and (ix) mixed waste.	
Amount of mixed MSW collected	kg/capita/year	Waste authorities and waste management companies	Annual amount of mixed MSW collected divided by the number of residents.	Territory administered or relevant local area	Waste Material efficiency	N/A	3.3.2
MSW sent to energy	kg/capita/year	Waste authorities and	Annual amount of MSW that is treated by either incineration with	Territory administered or	Waste	The annual amount of collected mixed MSW sent	3.3.3

Indicator	Common units	Main target group	Short description	Recommended minimum level of monitoring	Related EMAS core indicator[28]	Benchmark of excellence	Related BEMP [29]
recovery and/or disposal		waste management companies	energy recovery and/or disposal operations (such as landfilling or incineration without energy recovery) divided by the number of residents.	relevant local area	Material efficiency	to energy recovery and/or disposal is: - lower than 15 % of the national average of municipal waste generation ; or - lower than 70 kg/capita.	
MSW sent to disposal	kg/capita/year	Waste authorities and waste management companies	Annual amount of MSW that is sent to disposal (such as incineration without energy recovery or landfill) divided by the number of residents.	Territory administered or relevant local area	Waste Material efficiency	The annual amount of MSW sent to disposal is: - lower than 2 % of the national average of municipal waste generation; or - lower than 10 kg/capita.	3.3.4
Capture rate of a specific waste stream	%	Waste authorities and waste management companies	Amount of a separately collected waste stream divided by the total generation of the waste that was targeted by that separate collection, calculated thanks to the composition analysis of the mixed waste.	Territory administered or relevant local area	Waste Material efficiency	- The capture rate for waste glass separately collected as single fraction (i.e. not in a co-mingled collection system) is higher than 90 %. - The capture rate for waste paper and cardboard separately collected as single fraction (i.e. not in a co-mingled collection system) is higher than 85 %. - The capture rate for waste metals separately collected as single fraction (i.e. not in a co-mingled collection	3.3.5

Indicator	Common units	Main target group	Short description	Recommended minimum level of monitoring	Related EMAS core indicator[28]	Benchmark of excellence	Related BEMP [29]
						system) is higher than 75 %. - The capture rate for co-mingled waste packaging is higher than 65 %.	
Impurity rate of a specific waste stream	%	Waste authorities and waste management companies	Amount of non-target materials in a specific separately collected waste stream.	Territory administered or relevant local area	Waste Material efficiency	N/A	3.3.6
Biowaste in mixed waste	kg/capita/year	Waste authorities and waste management companies	Annual amount of biowaste included in mixed waste (calculated from the composition analysis of mixed waste) divided by the number of residents.	Territory administered or relevant local area	Waste Material efficiency	The annual amount of biowaste in mixed waste is lower than 10 kg/capita.	3.3.7
BEMPs for construction and demolition waste (CDW)							
Share of total collected CDW that is correctly segregated and managed towards reuse, recycling or recovery	%	Waste authorities and waste management companies	Annual amount of CDW that is correctly segregated and managed towards reuse, recycling or recovery divided by the total amount of CDW.	Territory administered or organisation	Waste Material efficiency	An integrated CDW management plan is implemented with a target CDW recycling rate in 2020 of at least 80 % and provisions for monitoring and enforcement mechanisms.	3.4.1
Number of collection points for asbestos waste	Number/100 000 residents	Waste authorities and	Number of collection points, in the relevant local area, for asbestos waste	Territory administered or	Waste Material	There is at least one collection point per	3.4.3

Indicator	Common units	Main target group	Short description	Recommended minimum level of monitoring	Related EMAS core indicator[28]	Benchmark of excellence	Related BEMP [29]
per 100 000 residents		waste management companies	per 100 000 residents.	organisation	efficiency	100 000 residents or free home collection for waste asbestos removed by residents.	
Efficiency of material recovery at the waste plasterboard processing plant	%	Plant operators	Total amount of waste plasterboard processed at the waste plasterboard plant minus the amount of rejects generated, divided by the total amount of waste plasterboard processed.	Processing facility	Waste Material efficiency	N/A	3.4.4
Efficiency of material recovery at the CDW processing plant	%	Plant operators	Total amount of CDW processed at the CDW processing plant minus the amount of rejects generated, divided by the total amount of CDW processed.	Processing facility	Waste Material efficiency	N/A	3.4.5
BEMPs for healthcare waste (HCW)							
Collection rates per fraction, per bed or per patient, according to the specific fractions collected in each healthcare facility	kg/patient/day kg/bed/day	Waste management companies	Daily amount of a specific waste fraction collected divided by the number of patients or beds in the healthcare facility.	Healthcare Facility	Waste Material efficiency	N/A	3.5.1
Quantity of HCW generated by households collected	kg/capita/year	Waste authorities and waste management	Annual amount of HCW generated by households and collected by a separate HCW collection system for residents divided by the number of	Territory administered or organisation	Waste	N/A	3.5.2

Indicator	Common units	Main target group	Short description	Recommended minimum level of monitoring	Related EMAS core indicator[28]	Benchmark of excellence	Related BEMP [29]
		companies	residents				
Share of HCW in mixed household waste	%	Waste authorities and waste management companies	Share of HCW waste in mixed household waste detected by the composition analysis of a representative sample.	Territory administered or organisation	Waste	N/A	3.5.2