EUROPEAN PARLIAMENT

STUDY

Policy Department
Economic and Scientific Policy

Impact assessment of recycling targets in the waste framework directive

(IP/A/ALL/FWC/2006-105/Lot4/C1/SC3)

IP/A/ENVI/ST/2008-6

PE 404.901

This study was requested by the European Parliament's Committee on Environment, Public Health and Food Safety.

Only published in English.

Authors:	**Mr. Christian Jervelund** **Mr. Simen Karlsen** **Mr. Marcin Winiarczyk** **Mr. Claus Petersen (Econet A/S)** Copenhagen Economics A/S Sankt Annæ Plads 13, 2 1250 Copenhagen K
With contributions from:	Claus Kastberg Nielsen (Copenhagen Economics A/S)
Administrator:	**Gian Paolo MENEGHINI** Policy Department Economy and Science DG Internal Policies European Parliament Rue Wiertz 60 - ATR 00L004 B-1047 Brussels Tel: +32-2-2832204 Fax: +32-2-2846929 E-mail: gianpaolo.meneghini@europarl.europa.eu

Manuscript completed in May 2008.

TABLE OF CONTENTS

EXECUTIVE SUMMARY

This study assesses the potential impact of setting binding targets for:

- Household and similar waste: 50 % preparing for re-use and recycling by 2020;
- Construction and demolition waste: 70 % preparing for re-use and recycling by 2020;
- Industrial and manufacturing waste: 70 % preparing for re-use and recycling by 2020 (primarily look at feasibility of setting a target);
- Prevention of all waste: Amount of waste in 2012 stabilised at 2009 level.

Following Commission's proposal of the Waste Framework Directive and Council common position, the European Parliament has proposed a set of amendments to establish these binding targets.

In short, 50% recycling of household and similar waste and 70% of construction and demolition waste seem feasible to reach for Member States. For both targets, evidence suggests that some Member States today are already complying with these targets. However, different Member States will face different compliance costs due to circumstances outside their influence, such as geography and composition of waste.

Proper data definitions are currently not in place for setting enforceable targets. This is even more so for industrial waste whereby it is currently not suitable to set a target on industrial waste: information on the origin (e.g. household, construction and various industries) responsible for generation of waste is not currently available. Furthermore, information on how much of the generated waste is recycled is likewise not available.

Based on the difficulties of defining what exactly is and is not covered by what definitions, it seems appropriate to point to the possibility of alternative targets. Policy makers could consider setting recycling targets on:

- Specific fractions such as paper, plastic and bio waste. Alternatively:
- All waste irrespective of origin; this would automatically cover industrial waste.

The idea of setting a target on waste prevention may not be enough to stabilise waste generation. It is evident that such a target can only be reached if Member States introduce a number of instruments providing the proper economic incentives for waste prevention. Furthermore, instruments must tackle waste generation throughout all parts of the value chain of a product. This also includes e.g. the design phase and the marketing phase. That is, parts of the value chain that is not directly linked to final waste generation and traditional waste management. The difficulties of identifying the origin of waste generated make it even harder for Member States to introduce effective instruments targeted at stabilizing waste generation.

1. INTRODUCTION

The European Commission proposed a revision of the Waste Framework Directive from 1975 (COM(2005) 667 final). Main objectives are to simplify the legal framework by repealing and integrating other directives into the Waste Framework Directive, and to incorporate into the directive the environmental objective of reducing the environmental impact from waste generation and management.

Following Commission's proposal and Council common position, the European Parliament has proposed to set binding targets for recycling (and preparing for re-use) of waste and prevention of waste with the purpose of reducing the environmental impact of waste. More specifically the European Parliament proposes the following targets:

- Household and similar waste: 50 % preparing for re-use and recycling by 2020;
- Construction and demolition waste: 70 % preparing for re-use and recycling by 2020;
- Industrial and manufacturing waste: 70 % preparing for re-use and recycling by 2020 (It is only looked at feasibility of setting a target);
- Prevention of all waste: Amount of waste in 2012 stabilised at 2009 level.

This study addresses in particular these four targets. The focus primarily is on the targets for household and similar waste and construction and demolition waste, but the study discusses also the feasibility of setting targets for industrial waste and waste prevention.

According to the European Topic Centre on Resource and Waste Management (EIONET) the most explicative definition on waste is the following[1]:

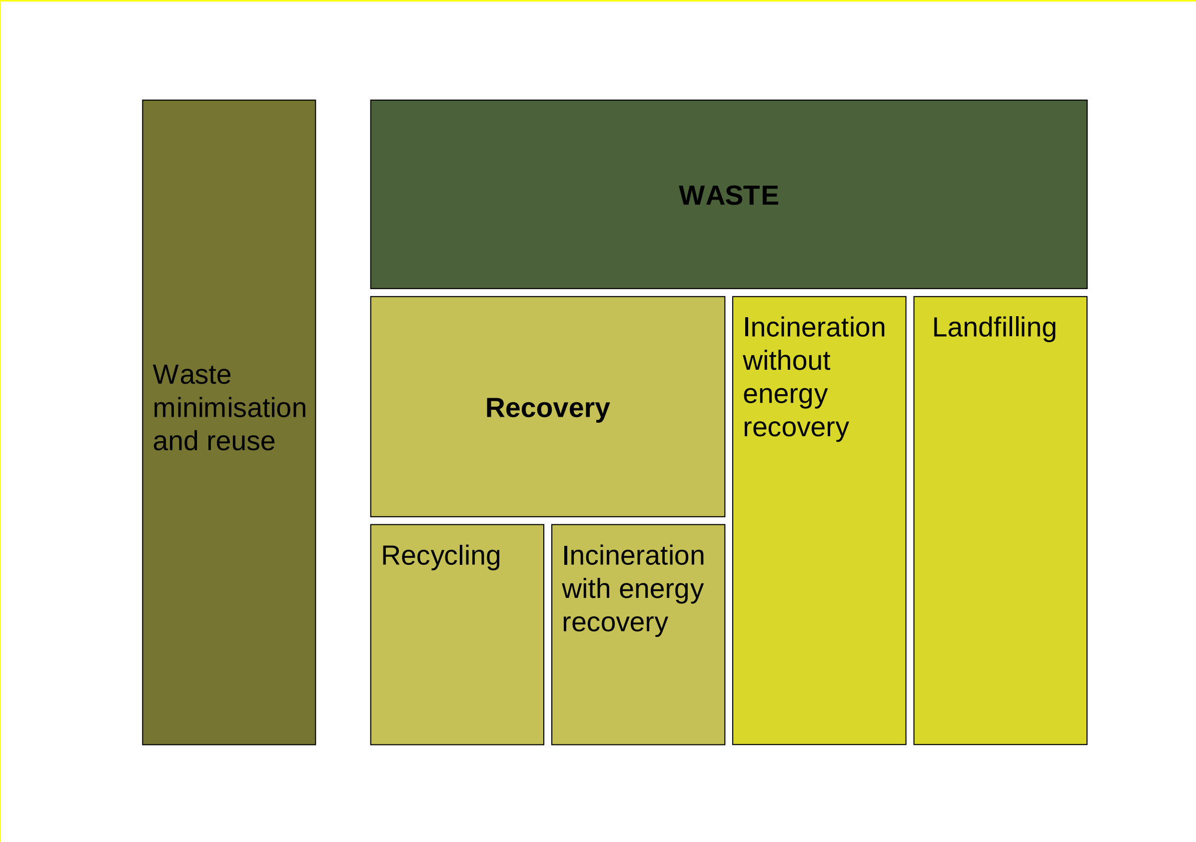
"Waste refer here to materials that are not prime products (i.e. products produced for the market) for which the generator has no further use for own purpose of production, transformation or consumption, and which he discards, or intends or is required to discard. Wastes may be generated during the extraction of raw materials during the processing of raw materials to intermediate and final products, during the consumption of final products, and during any other human activity".

The definition specifically omits from the definition of waste: "*Residuals directly[…] reused at the place of generation (i.e. establishment).* The keyword here is 'reuse' which means that products that are reused by definition never enter the waste stream.

Waste can be treated in a number of ways. It may be e.g. recycled, incinerated or land filled, cf. Figure 1.

[1] The definition is provided in the Joint Questionnaire OECD/Eurostat biennially send to all European countries. See http://waste.eionet.europa.eu/definitions/waste.

Figure 1: Treatment operations



Source: Copenhagen Economics

The information used in this study has been obtained through existing sources[2] and through interviews with more than ten waste experts representing EU authorities, firms and organisations.

[2] See bibliography on page 30

2. CONSTRUCTION AND DEMOLITION WASTE TARGET

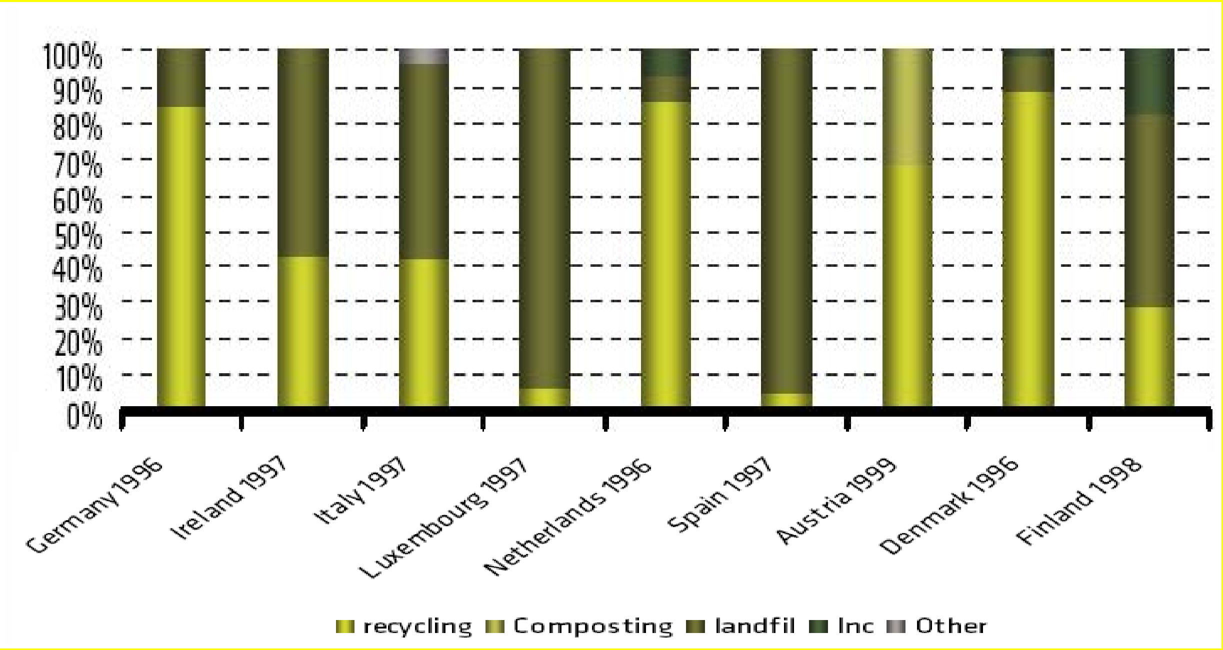
This chapter dives into the feasibility of the 70% recycling target on Construction and Demolition Waste (CDW). Achieving the 70% target is feasible, as demonstrated by some Member States[3] which currently recycle at least this share of CDW.

The characteristics of CDW generation, processing technologies and the potential demand for CDW recyclates in the Member States facilitate high rates of recycling which may be institutionalised with a target of 70% and a fiscal instrument such as a taxes or subsidies, for example. However, costs of compliance with the target will differ between Member States reflecting among other things, price of virgin materials and differences in enforceability of a target.

2.1 Feasibility of a 70% recycling target for CDW

Since the mid-1990s, Denmark, Germany and the Netherlands have been consistently recycling in excess of 70% of their CDW, cf. Figure 2. Hence, even in the absence of EU-level legislation, the countries had created conditions facilitating high recycling rates of CDW. The data is from the late 1990s, prior to the introduction of the Waste Statistics Regulation[4].

Figure 2: Treatment of CDW, selected EU countries, selected years 1996-1999.



Note: The data are from Eionet, however the original sources are the Eurostat/OECD Joint Questionnaire, supplemented with national statistics. There are specific uncertainties concerning the data from the Netherlands.
Source: EEA (2002) and Eionet (2006c)

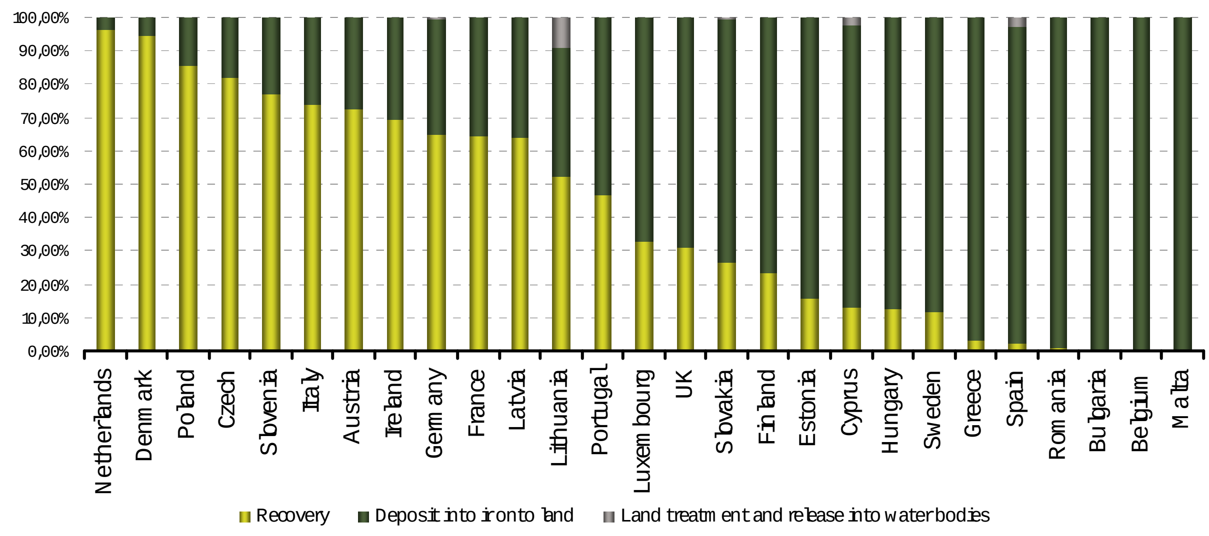
[3] For example: Denmark, where the introduction of a landfill tax has contributed to a dramatic increase in the recycling of CDW

[4] The Waste Statistics Regulation (EC) No 2150/2002 has been introduced to harmonize and strengthen reporting of waste statistics across the Member States. However, as of the time of writing, it is not possible to identify the treatment of CDW with data collected after the introduction of the regulation. Please see Section 2.3 for a discussion of data sources and issues.

Even more countries achieve recycling rates in excess of 70% when looking at latest available data collected under the Waste Statistics Regulation (WSR)[5] and disseminated by Eurostat, from 2004. Unfortunately, the representation CDW is not directly possible with the new data. Therefore, following Eurostat's advice[6], "Total mineral waste" could be an example as representing CDW. "Total mineral waste" is a category from the waste classification for statistics (EWC-stat) in Annex III of the Waste Statistics Regulation most resembling the old definition of CDW.[7]

Denmark and Netherlands achieve recycling of mineral waste in excess of 70% while Germany reaches about 65%. Furthermore, Poland, Czech Republic, Slovenia, Italy, Austria and Ireland also achieve over 70% recycling of "total mineral waste", cf. Figure 3.

Figure 3: Recovery of total mineral waste, EU countries, 2004



Note: The term Recovery we believe best captures recycling of the categories available in Eurostat. There is neither any Energy Recovery nor any Incineration of mineral waste in the Member States. Total mineral waste is the sum of Hazardous and Non-hazardous mineral waste.
Source: Eurostat; Waste Statistics Regulation (WSR)

2.1.1 Can other countries increase their recycling rates for CDW?

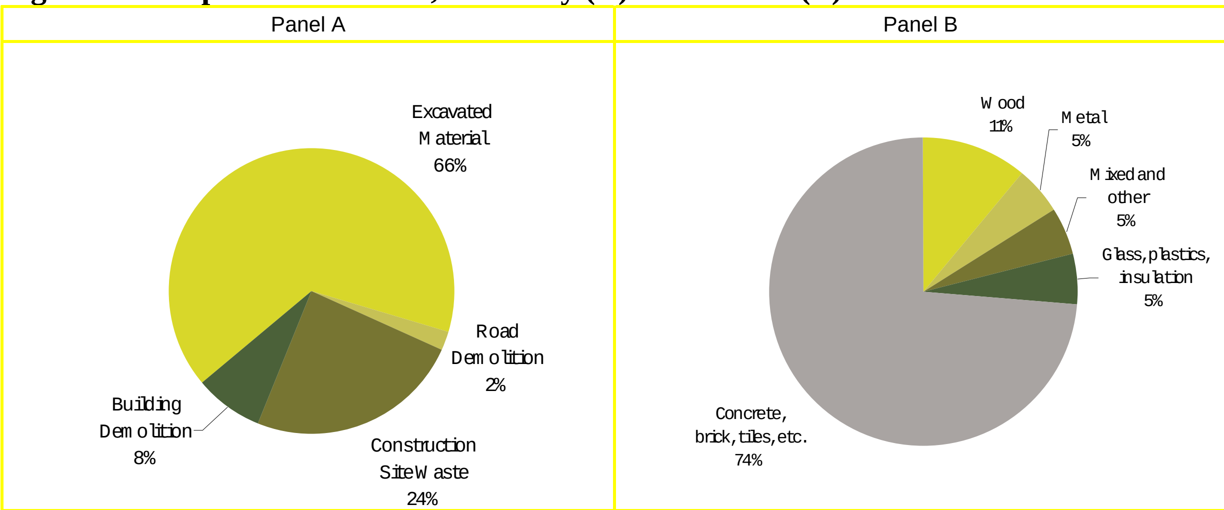
The experience of countries achieving high recycling rates might be generalised to countries achieving low recycling rates by means of introducing regulatory incentives, such as taxes or subsidies. This is because CDW as a stream possesses certain characteristics which make it intrinsically suitable for recycling. Four characteristics have been identified.

---

[5] Regulation (EC) No 2150/2002 of the European Parliament and of the Council of 25 November 2002 on waste statistics.
[6] This is based on telephone conversations with Eurostat.
[7] In Section 2.3, we outline in more detail how limitations of the currently available statistical reporting schemes hinder the monitoring of the recycling target.

First, the waste fractions are in relatively stable and concentrated supply, well defined and separable and largely suitable for recycling. CDW consists of several large and well defined fractions as per Chapter 17 of the Consolidated European Waste Catalogue[8], cf. Figure 4, panel A. The waste community also sometimes refers to "core CDW", which excludes soil and stones, cf. Figure 4, panel B.

Figure 4: Composition of CDW, Germany (A) and the EU (B)



Source: Panel A: Cowam (2006); Panel B: Eionet (2008), *http://waste.eionet.europa.eu/themes/waste/#4*

Excavated material, including excavated soil from contaminated sites[9], accounts for the largest fraction of CDW by mass. Non-contaminated soil is naturally well suited for recycling in various construction and engineering projects. Denmark legally bans the landfilling of surplus non-contaminated waste soil, which *de facto* requires its prevention or recycling[10]. However, even contaminated soil, which requires disposal in special, licensed landfills, can be treated by means of physical, chemical or biological processes in order to decrease the level of contamination and reduce its volume.

The next fraction by mass is construction site waste, comprising building materials of which the most significant ones are: waste of mineral origin (bricks, concrete, ceramics), metals (pipes, wire), or chemical origin (Styrofoam, plastics, insulation materials) as well as glass and wood. With the exception of hazardous waste, whose separation is difficult due to low concentrations, most of the large fractions yield themselves relatively well to recycling.

Demolition comprises the same materials. In general, it is more difficult to separate the individual waste materials in demolition waste than construction waste. This complicates recyclablity, although at the same time the removal of contamination from demolition waste is desirable on the ground of a positive environmental impact. Older demolition waste can also be contaminated, e.g. with heavy metals or chemical substances (PCB, asbestos, insulation materials).

Road demolition waste accounts for a small overall fraction of CDW generated, consisting of asphalt and mineral waste (gravel and concrete).

[8] LoW also referred to as the List of Wastes has been established by the Commission Decision 2000/532/EC of May 3, 2000. http://www.environment-agency.gov.uk/commondata/acrobat/tgnappendixa.pdf
[9] Note: excavated soil from contaminated sites is not "hazardous waste" unless a specific concentration of the contaminants is present.
[10] http://glwww.mst.dk/udgiv/Publications/1999/87-7909-571-2/html/bilag03_eng.htm

Second, the supply of CDW often coincides with the demand for construction materials, sometimes even in close geographical vicinity of each other. Locations of the supply of CDW and the demand for CDW recyclates are important because they determine the transportation costs in the recycling process. Low transportation costs for CDW in comparison to virgin materials facilitate CDW recycling and avoidance of virgin materials use.

Transportation costs of CDW are shaped by two features: urbanization and the access to virgin materials.

Urban settings are characterised by low transportation costs of CDW (their supply is concentrated and often coincides with the demand for recyclates in construction projects). In addition, urban settings often imply relatively higher transportation costs for virgin materials, as they are often less available in urban locations which means that distance and hence transport costs increase. In rural settings, the transportation costs can be more favourable for virgin materials, since CDW generation is more dispersed and its generation may not always coincide with demand.

Third, the processing technology seems readily available and can be deployed efficiently, both on-site (decentralized recycling) and off-site (centralized recycling). The recycling technology for CDW is readily available and relatively inexpensive. It mainly involves mechanical treatment (crushing, sieving) or thermal treatment. There are two broad types of technology that can be deployed depending on specific circumstances:

On-site processing can be deployed at the site where CDW arises, allowing e.g. separation at source as a result of selective demolition. Less sophisticated technologies of crushing, sieving, can be used since sorting can take place on site by selective demolition.

Off-site processing can be optimized for specific types of CDW treatment and production of recyclates, e.g. more sophisticated crushing and sieving, sorting, etc can be implemented.

Fourth, CDW recyclates generally have some positive economic value. Their relative value over virgin materials increases with the cost and energy savings that can be realised over virgin materials extraction, transportation and processing into construction materials.

CDW recyclates have positive economic value as they are substitutes for construction materials derived from virgin resources. CDW recyclates have multiple uses in construction as road bases, general fills, drainage, pavement aggregate, additives to asphalt mixes and cement production additives for engineered boards. Outside the construction industry, some CDW waste can be used as animal bedding and in agriculture.

2.1.2 Regulatory management of CDW treatment

The Danish experience is illustrative of the effectiveness of a fiscal instrument in the form of a landfill tax in enforcing a high recycling rate for CDW. In 1984, Denmark was recycling 11% of CDW. A “Tax on Waste” was introduced in 1987. The Tax was differentiated so that recycled waste was exempted – thus effectively it had become a tax on landfilling waste.[11] In the following years, the tax rate of landfilling was increased. Relatively, landfill had become increasingly expensive, cf. Table 1.

[11] The tax rate was different for landfill and incineration (the latter remaining constant) but as incineration is generally not a viable option for treating a significant fraction of CDW, we do not discuss the developments in the incineration tax in Denmark.

Table 1: Danish taxes on incineration and landfilling, 1987-2001

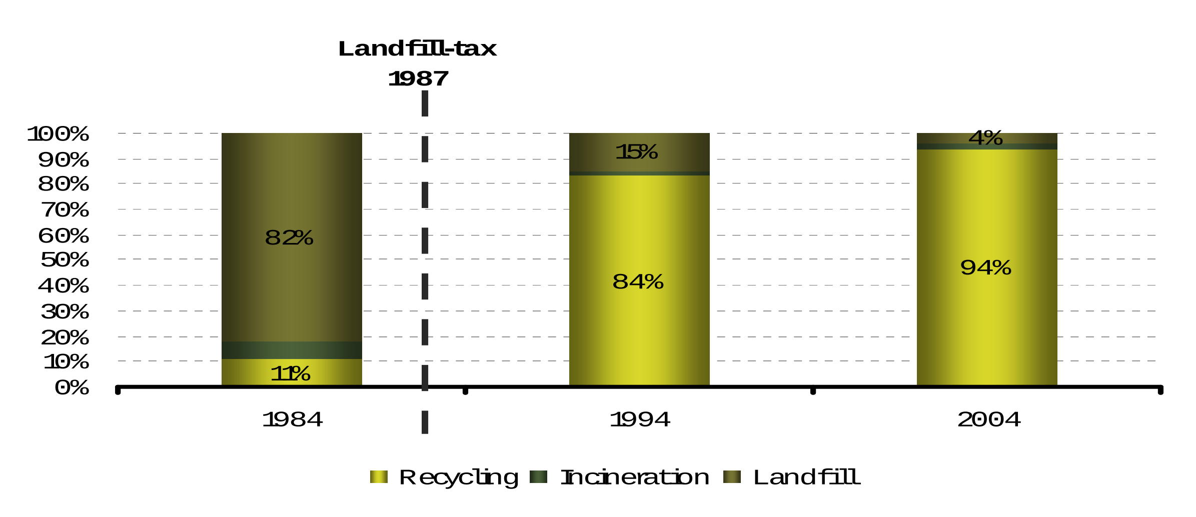
Year / Treatment	1987	1990	1993	1997	1999	2001
Incineration (DKK / tonne)	40	130	160	210/260*	280/330*	330
Landfill (DKK / tonne)	40	130	195	335	375	375

*Note: 1 € currently equals 7.5 Danish kroner (DKK). *: with energy recovery/without energy recovery. Note that incineration is not in practice a management option for CDW.*

Source: Danish EPA.

The tax-driven development in Denmark has been successful in stimulating recycling, and in 2004, 94% of the waste was recycled, cf. Figure 5.

Figure 5: Increase in CDW recycling following landfill tax introduction in Denmark



Source: Eionet (2006a), Country fact sheet Denmark.

Two current regulatory initiatives are mentioned which may indirectly impact on Member States' compliance with the 70 % recycling target: the Landfill Directive (1999/EC/91) and the Environmental Liability Directive (2004/35/EC; 2006/21/EC).

The landfill directive may turn out to increase the incentive to recycle CDW. The landfill directive bans co-disposal of hazardous and non-hazardous CDW. Land filling of hazardous and non-hazardous CDW must take place at separate sites. Land filling CDW continues to be a dominant treatment option in many MS.

The ban on co-disposal is likely to increase the cost of landfilling CDW since landfilling hazardous waste in specially licensed sites is expensive[12]. Furthermore, the requirement to pre-sort CDW into specific waste streams may increase the demand for the recyclates. As a result, the landfill directive is expected to reduce the reliance on landfill for CDW[13] and indirectly support the recycling target or contribute to waste prevention.

The environmental liability directive may turn out to reduce the incentive to recycle CDW. The environmental liability directive introduces a 30 year liability on e.g. buildings. Since the quality of recyclates is more uncertain than the quality of virgin materials, developers may reduce demand of recyclates in light of the 30 year liability; or they will demand a lower price on the recyclates.

[12] Also, contaminated CDW must be pre-processed prior to disposal to separate the contaminated fractions, which also increases the cost of landfill. Contaminated soil will require pre-treatment prior to disposal.
[13] www.environment-agency.gov.uk/commondata/103599/hwcl_qa_v.1_844475.doc

Another possibility is that they will demand greater certainty with regards to the quality of the recyclates. Guaranteeing a certain quality will increase costs of processing CDW into recyclates thereby increasing the price and reducing demand of recyclates. Either way, the incentive to recycle CDW may be reduced. The directive allows, however, for exceptions to the liability regime.

2.2 Cost of compliance across Member States

Implementation of the target may be difficult in some countries, because of differences in local conditions. This means that the level of regulatory (e.g. tax) incentives must be aligned to the local conditions. In general, a distinction between two polar groups of countries – or settings – can be made. In the first polar setting a favourable set of conditions will prevail for the recycling of CDW even without regulatory incentives. In the second polar setting, the set of conditions will discourage high recycling of CDW. The following paragraphs examine how economic actors who are faced with the question whether or not to recycle CDW are influenced by the circumstances of each of the polar settings.

2.2.1 The first setting: favourable conditions for recycling CDW

In favourable settings, economic agents are faced with high incentive to recycle CDW for at least four reasons.

First, virgin materials are expensive relative to recycle. This is either because virgin materials are not readily available locally or their transportation costs from outside countries become high due to distance in comparison to transporting locally available CDW recyclates. Such countries will have a natural incentive to recycle CDW, and historically the lack of virgin construction resources has driven the relatively high recycling rates of CDW in countries like Denmark or the Netherlands.

Second, local geography may facilitate transportation of bulky items such as CDW within a country, which would facilitate recycling. This is the case in Germany, where excellent transportation infrastructure is an incentive to recycle CDW even though virgin materials are also relatively easily available.

Third, in countries with high transparency and low possibility of evasion, there are low risks associated with non-compliance of e.g. a landfill tax. This is again the case in Denmark, where it is firstly geographically very difficult to dispose of CDW in illegal landfill and escape detection and secondly there is high transparency and general compliance with state institutions.

Fourth, in some countries there is greater emphasis on the environmental agenda which calls for the avoidance of landfill and the recycling of CDW. Germany, the Netherlands and Denmark are again examples of such countries, which manifests itself in strong institutional prioritisation of waste treatment technologies, such as recycling. This takes the form e.g. as research into recycling technologies (bringing their cost down and stimulating recycling) and monitoring of waste management e.g. on the communal level (requiring reporting systems and the production of relevant data by authorities).

In light of the above features, in favourable settings a relatively modest landfill tax might be very effective in making the recycling of CDW its dominant treatment. In other words, the level of regulatory incentives does not need to be particularly high in settings where there is already an environment conducive to recycling CDW. For the same reason, few problems with enforcement issues can be expected.

2.2.2 The second setting: unfavourable conditions for recycling CDW

At the other end of the spectrum are settings with unfavourable conditions for the recycling of CDW.

First, economic agents in such settings will have good access to virgin materials and therefore less incentives to use recycles as a substitute to virgin materials. In countries with abundant virgin construction like Sweden, Finland or Italy, the transportation costs for virgin materials are low and lower than transporting CDW.

Second, their rural settings mean that the generation of CDW may be more dispersed than in urban settings requiring even more transport, and hence further increase the transportation costs for CDW. In such cases, it may currently be both economically and environmentally preferable to landfill CDW than to transport to the nearest recycling facility.[14]

Third, the geographic features (large distances, rural areas, mountains), in addition to raising transportation costs of CDW, make illegal disposal of CDW more difficult to detect. For example, Southern European countries are often characterised by such geographic features. A lower chance of detection increases the risk of evasion, making it more likely. Furthermore, it is assumed that countries in the second setting are also characterised by lower transparency and weaker institutions making enforcement of regulatory instruments less effective.

Fourth, some countries use materials that are harder to recycle. For example, Sweden and Finland have tradition for building houses made of wood; wood is difficult to recycle.

Therefore, in unfavourable settings, a relatively large landfill tax would need to be implemented in order to reverse the unfavourable *a priori* incentives. A modest tax may not be enough to change the behaviour of economic agents. However, the higher the tax, the larger the incentive to evade it becomes. This incentive is amplified if enforcement is weak and there is low probability of detection. Thus, countries with unfavourable settings for the recycling of CDW would need to introduce a higher tax, and secure tougher enforcement schemes if the target is to be achieved.

2.3 Monitoring and enforcement of targets

Article 8a of the “Draft legislation resolution” document of the European Parliament[15] requires for the purpose of data harmonisation that Member States apply the Waste Statistics Regulation (WSR) when producing and disseminating data on waste. However, there is a problem with the implementation of the WSR, because the available waste definitions in Eurostat can only approximately be used to represent the treatment of CDW. Therefore, with the current statistical data, it may prove difficult to set a credible target for CDW recycling in all Member States. In a nutshell, the problem with the WSR in relation to CDW is twofold:

- In the WSR data on waste treatment, it is not possible to isolate CDW.
- It is necessary to determine whether “recovery” in the WSR data is representative of “recycling”.

The two issues are being examined in turn in the following paragraphs.

[14] http://ec.europa.eu/enterprise/construction/suscon/tgs/tg3/demfin.htm

[15] Recommendation for Second Reading, on the Council common position for adopting a directive of the European Parliament and of the Council on waste, (11406/4/2007 – C6 0056/2008 – 2005/0281(COD)), Committee on the Environment, Public Health and Food Safety

2.3.1 Lack of data on the treatment of CDW

CDW is a term defined in Chapter 17 of the European List of Waste[16] (LoW). The LoW provides a very detailed list of the waste materials classified under the CDW category.[17] The LoW classification is not used for reporting of data in Eurostat, however. Instead, the WSR transposes the LoW into a more aggregate classification, called the European Waste Classification for Statistics[18] (EWC-Stat). The data available in Eurostat are disseminated under the WSR where classification is according to the EWC-Stat. On the EWC-Stat level in Eurostat it is not possible to identify CDW as a separate waste stream when looking at the treatment data.

This problem has been acknowledged by the data provider, Eurostat. Apparently, Eurostat is currently working on possible solutions which will allow obtaining a better representation of CDW treatment in the EWC-Stat. In recognition of the problem, Eurostat recommends using the category "EWC_12 Mineral Wastes" as an *ad-hoc* approximation to CDW. But the EWC_12 definition is a wider as it contains certain other types of waste, more likely to be industrial in nature, cf. Table 2.

Table 2: Composition of Mineral Wastes in Eurostat data

EWC-Stat categories	Availability in Eurostat
EWC_12 Mineral Wastes	Available in Eurostat – but over representing CDW
EWC_12.1 Construction and Demolition Wastes	Not separately available in Eurostat – but representative of CDW. Included in EWC_12
EWC_12.2 Asbestos Wastes	Not separately available. Can represent hazardous CDW. Included in EWC_12.
EWC_12.3 Waste of naturally occurring materials	Not separately available, included in EWC_12
EWC_12.4 Combustion wastes	Not separately available, included in EWC_12, but not required
EWC_12.5 Waste refractory materials	Not separately available, included in EWC_12, but not required
EWC_12.6 Contaminated soils and polluted dredging spoils	Not separately available, included in EWC_12

Source: ANNEX III of the WSR; Eurostat
http://ec.europa.eu/eurostat/ramon/other_documents/ewc_stat_3/annex_1_and_3/annex_1_and_3_en.pdf

2.3.2 Lack of "recycling" as a treatment option

The next problem concerns the lack of "recycling" as a treatment option in the WSR data. Currently, there is no "recycling" in the treatment options, but "recovery" is provided instead. The two terms are not completely equivalent.

The term "recovery" spans a concrete list of "recovery operations" defined in an annex to the Waste Framework Directive. Of these operations, roughly 90% can be classified as recycling, while the remaining 10% cannot be classified as recycling.[19] Therefore, it should be investigated in detail whether the WSR definition of "recovery" is sufficient to represent data for measuring compliance with the target defined in terms of "recycling" of CDW.

A separate issue is compliance with the implementation of the LoW and state of reporting on the EWC-stat level by specific Member States. Prior to the introduction of the WSR, there were problems with lack of harmonisation of data definitions provided by the different national statistical offices.

[16] Established by Commission Decision 2000/532/EC.
[17] There is a parallel discussion on when a specific material from the LoW becomes waste. This discussion is well covered in the drafting documents and we do not consider it here further.
[18] http://ec.europa.eu/eurostat/ramon/other_documents/ewc_stat_3/index.cfm?TargetUrl=DSP_EWC_STAT_3
[19] Telephone interivew with Eurostat, April 30, 2008.

In the waste community, there is a wide understanding that the data collected prior to the WSR are not readily comparable across Member States. There is some risk that there may be a problem with data comparability between Member States due to their different state of implementing the new classifications for reporting waste statistics. Furthermore, so far only the first wave of WSR statistics is available on Eurostat, with the base year 2004[20]. The next wave of the data will have the base year 2006 but the data was not available at the time of writing. As a last issue, recovery data contains imported waste but does not necessarily account for exports.

The key takeaway from the above discussion is that by using the WSR data, it is not possible to directly obtain information on the recycling of CDW. Both CDW and "recycling" must therefore be clarified. Otherwise, endless discussions are likely to occur on which type of waste and what treatment operation ought to count towards the 70 % target.

[20] There is more recent data from 2005 and 2006 but it is only available for municipal waste generation, incineration and landfilling as a part of the Eurostat Structural Indicators.

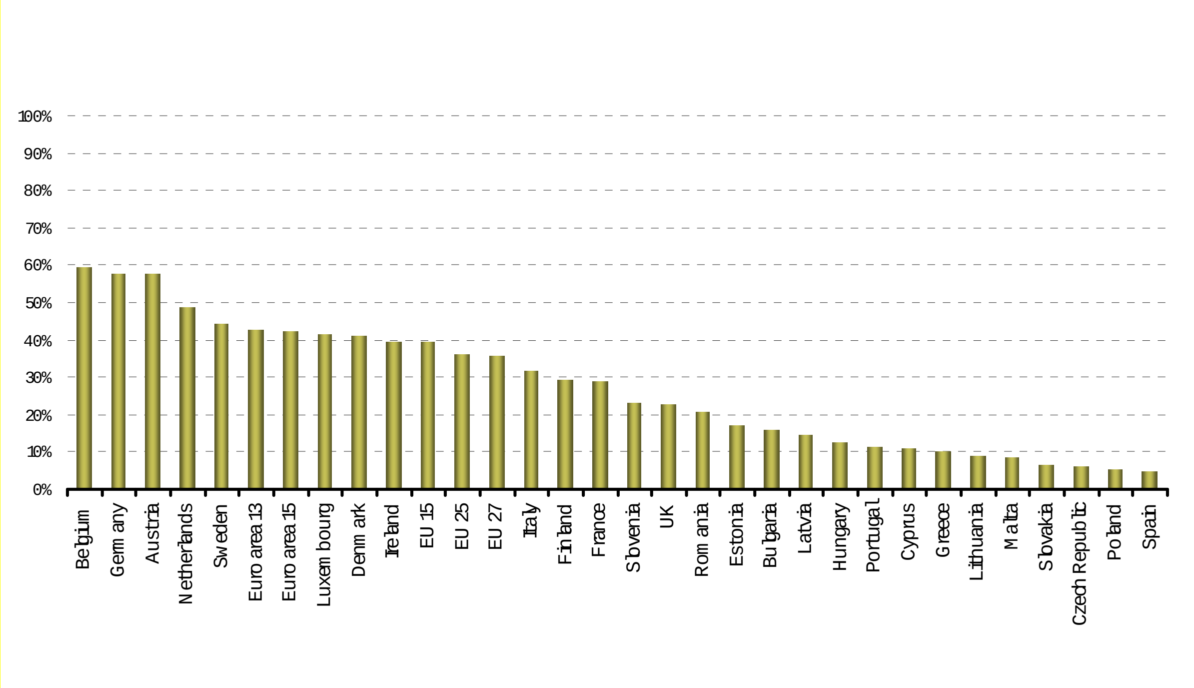
3. HOUSEHOLD AND SIMILAR WASTE TARGET

This chapter assesses the feasibility of the 50 % recycling target on household and similar waste (HHW). It can be concluded that achieving the 50% target is feasible, but ambitious. The reason for it seeming feasible is that a sufficient amount of waste fractions may be recycled based on existing technology, i.e. mechanical, biological and chemical treatment. It is ambitious because it does not seem feasible to recycle all of HHW but only certain fractions making up around 70-80% of HHW; and of these fractions only a certain proportion can actually be recycled in an economically meaningful way.

3.1 Feasibility of a 50% recycling target for HHW

Based on available data, several countries have considerable recycling of HHW. In fact, three Member States, Belgium, Germany and Austria, are registered with recycling in excess of 50%, cf. Figure 6.

Figure 6: Recycling (material recovery) of Municipal Solid Waste in the EU in 2004



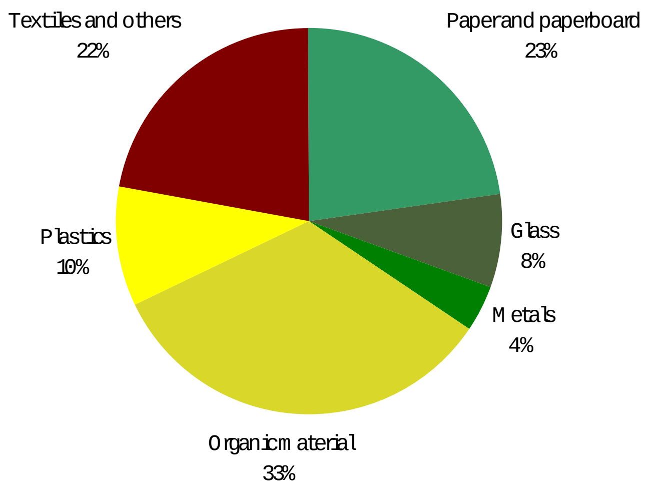
Note: Figures for Spain and Estonia are from 2003. Original source is Eurostat Structural Indicators on municipal waste, supplemented with national statistics from Germany, Spain, the Netherlands and Estonia.
Source: EEA (2007)

However, the figures on recycling rates appear to be somewhat overestimated. It is important to beware of that the figures on recycling rates are not directly registered but are the residual figures when subtracting the management alternatives of incineration, other recovery operations and land filling. For instance, a recycling rate for Denmark around 40% is above what Danish industry experts indicate in interviews. Consequently, the recycling figures could rather reflect the potential recycling rates today and not the actual rate.

Nevertheless, it seems likely that it is possible for most Member States to attain the 50% target. This is due to that the most fractions of HHW are recyclable, i.e. there are recycling technologies available for sufficient amount of fractions and there is a market for the end-products.

The recyclable fractions include paper, glass, cardboard, plastic and metal as well as organic waste, i.e. kitchen and garden waste. On EU average, these fractions constitute about 75% of all HHW, cf. Figure 7. However, about 25% of the waste appears excessively costly to recycle non-recyclable (textiles, laminates, tissues, diapers, and other combustibles).

Figure 7: Composition of municipal waste 2001-2005



Note: Simple average of 13 European countries including AUT, BEL, DNK, FRA, DEU, HUN, IRL, ITA, LUX, NLD, PRT, SVK, and ESP. The selection is based on availability of data in the period 2001-05.
Source: OECD (2007)

This means that in order to reach the 50% target set for the total amount HHW, it will be in fact necessary to recycle at least two thirds of the 75% recyclable fractions. One should bear in mind that even for recyclable fractions there is a maximum threshold beyond which recycling becomes either uneconomical, or begins to exhibit negative environmental consequences (e.g. due to increased transport emissions), or both[21]. In practice, the recyclable rate of each fraction is less than 100%.

As the characteristics of the HHW fractions vary considerable, the fractions are below divided into different groups based on to what extent it makes environmentally and economically sense to recycle the fractions.

3.2 The three fractions of HHW

The specific waste materials comprising HHW are characterised by different economic and environmental potential for recycling. This section distinguishes between three groups of waste materials: green, yellow and red, depending on their economic and environmental potential for recycling, cf. Table 3[22]. Materials in the green and yellow groups are most readily recyclable. The red group comprises materials that are not recyclable.

---

[21] The reasoning is as follows: It is easier to increase the recycling of e.g. paper from 40% to 50% than it is from 80% to 90%. It is virtually impossible to recycle 100% of paper. We explore these issues in the following section.

[22] It can be local circumstances that determine whether some waste materials belong to a green, yellow or red group in a specific country or region. Furthermore, the relative composition differs across Member States and/or regions.

Table 3: Composition of green, yellow and red groups

Group	Waste materials	Percentage of total HHW, EU
Green	Paper, glass, metals (ferrous metals, non-ferrous metals, also covered by the Packaging Directive)	27%
Yellow	Bio waste, plastic, cardboard	51%
Red group	Remaining waste, incl. textiles, tissues, diapers, laminates, other combustible materials	22%

Note: Simple average of 13 European countries including AUT, BEL, DNK, FRA, DEU, HUN, IRL, ITA, LUX, NLD, PRT, SVK, and ESP. The selection is based on availability of data in the period 2001-05.
Source: OECD (2007) and Copenhagen Economics.

3.2.1 Green group

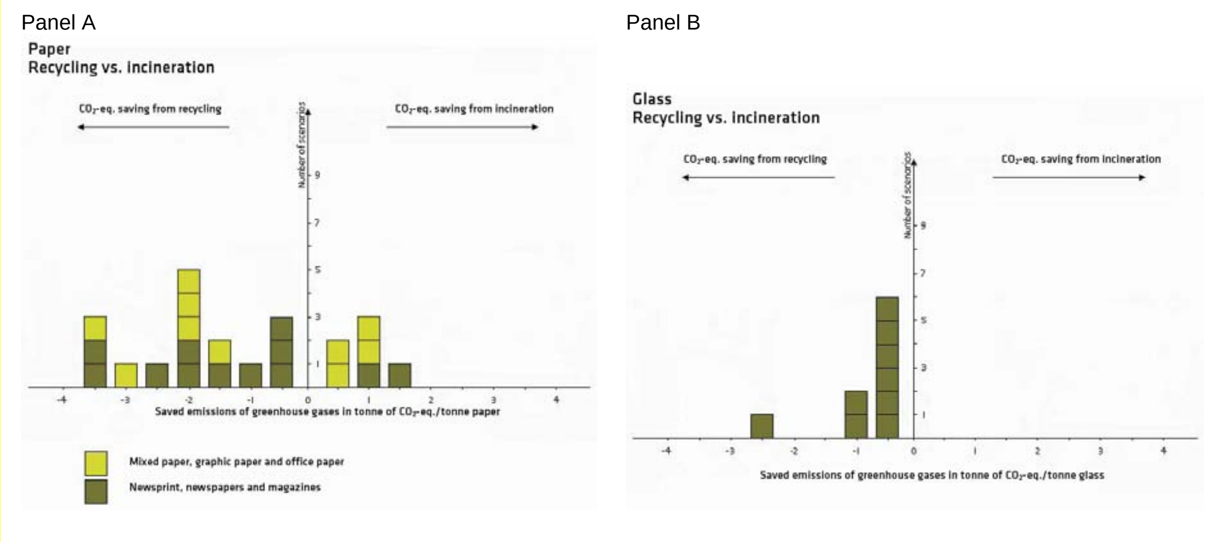
Environmental issues
For the three main waste materials in the green group, life cycle analysis studies show that it is environmentally most advantageous to recycle paper, glass and metals as opposed to other treatment possibilities, including incineration or landfill. Landfill is from an environmental point of view the least advantageous option and the Landfill Directive works in the direction of limiting the reliance on landfill as a waste treatment option.

Unfortunately, the available life cycle analysis studies do not make it possible to identify the household as the origin of waste they analyse. The lifecycle analysis study dealing with paper concerns waste material in aggregate, irrespective of whether it comes from household, industrial or construction activities (e.g. as packaging). Identifying the source is important because the environmental impact of recycling paper is likely to be different for households, industry or construction due to e.g. differences in transportation distance related to the collection and sorting systems which are different for households, industry and construction waste.[23]

Nevertheless, the life cycle analyses are illustrative of the potential environmental benefits for recycling – the exact amount varying due to local circumstances, as explained, cf. Figure 9.

[23] Furthermore, even for paper waste originating in households, there is likely to be variation in the environmental benefits. For example, in remote areas, the benefits of recycling paper are likely to be diminished due to the extra transportation necessary to get the waste to the recycling plant.

Figure 9: Environmental impacts of recycling paper and glass vs. incineration



Note: Each box represents a study. For example, a box in -2 represents a study which found a saving of 2 tonnes of CO_2-equivalents when recycling paper compared to incineration.

Source: WRAP (2006) Ökopol (2008)

Technology issues

Recycling of waste materials from the green group can take place in a 'closed loop' or 'open loop' manner. 'Closed loop recycling' means that the recyclates can be used as inputs in the production of the same finished products from which the recyclates have been themselves derived. For example, paper recyclates from newspapers are used as additives in the production of paper from virgin resources to make newspapers; metal and iron recyclates from packaging are inputs for the production of metal iron from virgin resources to make new packaging. 'Open loop recycling' means that the recyclates can be used to produce other products, e.g. glass recyclates from damaged bottles can be used to produce glass fibre. In brief, there is a large variety of recycling options for materials in the green group.

Recycling technologies for green group materials are available. Firstly, there is a range of sorting technologies, including mechanical and manual sorting where it is possible to separate the specific materials from HHW depending on how the materials have been collected. These technologies are relatively inexpensive and readily deployable. Secondly, on the processing a range of closed or open loop technologies is also readily available.

Demand issues

All of the recyclates in the green group have positive economic value and for some there is an international market. Glass recyclates tend to be more regionally processed, especially when closed loop technologies are used, though also in the case of open loop. In the case of other waste, good quality recyclates are primarily processed in Europe whereas poorer quality recyclates are exported, e.g. to China. There are some seasonal demand patterns in the trade, however, and for instance there have been reports in April 2008 that there were substantial stocks of waste paper for processing in Asia as well as in several EU Member States.

The magnitude of the economic value depends on supply / demand conditions in the markets, and is further influenced by quality. For example, there are about 50 quality categories for paper. The price difference between poor quality (e.g. mixed paper and board) and good quality (newspaper) grades of waste papers can be as high as €25-35 per tonne.[24]

[24] Expert interviewee statement.

Regional differences in supply and demand conditions furthermore determine the volatility of prices. Over the last 10 years, the prices were generally satisfactory for recyclers who could derive profits from the recycling of paper. However, there are expectations of falling prices on paper waste in the near future. Good prices on paper are likely to foster the implementation of more efficient collection systems leading to better quality paper waste.

There is a similar story for glass and metal waste. Glass is sorted according to colour, and the price depends on the purity of the fractions: white and coloured glass. For metal and steel, there has been a positive development in prices. Furthermore, the sorting technologies make it relatively easy to achieve high quality waste for recycling.

3.2.2 Yellow group

Environmental issues

The environmental benefits from recycling the materials in the yellow group are ambiguous. Six case studies undertaken using the life cycle analysis methodology show, for instance, that recycling of cardboard leads to greater CO_2 savings compared to incineration. But seven case studies applying the same life cycle methodology indicate that incineration leads to greater CO_2 savings than recycling. A similar story holds for plastic. Of course, care must be taken when interpreting these findings since the studies do not explain whether the quality of cardboard was the same in all case studies.

Life cycle analysis studies comparing composting and biogassification versus incineration show that composting is an environmentally worse option than biogassification or incineration. This is the case for two reasons. Firstly, composting does not offer the possibility to supply CO_2-neutral fuel e.g. for the production of renewable electricity. On the other hand, composting gives off CO_2 and water, nevertheless, but without the associated energy recovery. Secondly, compost that is achieved as a product of recycling can have different values – from valuable to no value, which itself is close to a waste product. Only some of the compost produced has the potential for making a positive contribution to agricultural soils.

From a life cycle analysis perspective, biogassification offers equal environmental impacts as incineration. Biogassification gives raise to biogas that is a CO_2 neutral fuel that can be used for the production of renewable electricity. The residues, which are less by mass than in the case of composting, are similar to compost in nature. The lower amount of residue can be of advantage in cases where the residue has little economic value.

Technology issues

On the technology side, there is available technology for sorting and processing of waste materials in the yellow group. Separation at source is relatively expensive, however, but contributes to lowering the treatment costs downstream. Central sorting involves lower collection costs but implies higher downstream treatment costs.

Cardboard and plastic are typically processed by means of closed loop technologies. However, the recycling of plastic can be complicated due to the difficulties with maintaining sufficient quality of the recyclates.

For bio waste, composting is a readily available technology. Composting in the open is relatively cheap. Composting in closed containers is more expensive, but can be more controllable and give raise to better quality compost.

Furthermore, a controlled amount of energy recovery can be obtained,[25] while there is evidence that economies of scale can improve overall economic efficiency. Should any of the recycling technologies not be feasible, the alternative is incineration. The Landfill Directive bans the disposal of bio waste in landfills.

Demand issues

Cardboard and plastic waste is traded on an international market. High quality cardboard and plastic waste is directed to closed loop processing but lower grade cardboard and plastics must be treated by open loop technologies. In open loop technologies, the utilisation of cardboard and plastic recyclates substitutes other raw materials, such as wood and metal. Furthermore, there is a trend for processing high quality fractions locally and exporting lower quality waste.

Composting takes place locally and its use is also local. High quality compost has positive economic value, and there is demand for it e.g. in golf fields and sports facilities. Lower grade compost can be used as a cover for landfills or for constructing noise-damping walls alongside highways.

3.2.3 Red group

The green and yellow groups cover the largest part of HHW, about 75%. The remaining parts constitute non-recyclable waste, which is labelled 'the red group' in this study. It consists of fractions for which currently there are no readily available recycling technologies. The primary purpose for separate collecting of such fractions is reuse – e.g. of textiles where processing is less of an option. 'Reuse' of certain fractions raises the issue of definitions – whether textiles to be reused are classified as waste or not.

Textiles have not always been a separately defined fraction of HHW for which data is available. In some countries textiles and shoes are collected for reuse whereby they may not be classified as waste products. Studies show that up to 70% of the collected textiles and shoes are reusable, while the rest can be processed into rags, fillers or becomes incinerated. However, the primary purpose of collecting textiles is reuse. Textiles are therefore not classified as having any real recycling potential.

Wood, in the form of transport packaging, is often reused in the EU. However, transport packaging is outside the scope of HHW. HHW, however, contains the wood fraction as 'bulky waste'. In these cases, wood can be reused, especially in the waste comprises furniture and similar products. Otherwise, it is difficult to recycle wood; accordingly classified in the red group.

Waste Electric and Electronic Equipment (WEEE) is regulated by a dedicated Directive (2002/EC/96). WEEE is separately collected, sorted and reused where possible. The processing is, however, very costly.

There are several further fractions which do not yield themselves to recycling, including laminates, tissues, diapers and other combustible and non-combustible waste.

[25] Through expert interviews we have noted an uncertainty as to when composting with energy recovery (biogas production) ceases to be classified as recycling operation and becomes recovery operation. This reflects a need for more precise definitions in this area.

Summary

Table 4 summarises the economic and environmental impacts from the recycling of the three fractions of HHW.

Table 4: Economic and environmental impacts of recycling fractions of HHW

	Environment	Technology	Demand
Green	+	+	+
Yellow	0	+	+/0
Red	+	÷	÷

Source: Copenhagen Economics

3.3 Cost of compliance across Member States

Examining the available data on HHW treatment across the Member States, there are considerable differences in the state of recycling. The distance to the 50% target varies dramatically between the countries, from a few percent by which some Member States miss the target, to other Member States which virtually do not recycle HHW.

It is important to stress that the differences do not make the 50 % target impossible but its achievement will be more difficult for the Member States that currently recycle very small amounts of their waste. The target might nevertheless be possible in the suggested timeframe (by 2020), also given that Article 8a of the proposed directive gives Member States recycling less than 5% of HHW a 5 year long extension of the compliance deadline. This section outlines the structural differences across the Member States to highlight under what circumstances it may be more difficult for some countries to achieve the target. It focuses on three main structural features which are, differences in:

- collection and sorting systems;
- the composition of HHW;
- the available treatment technologies.

Below it is explained the implication of each of these features for Member States' ability to reach the target.

Collection and sorting systems

In general, HHW is handled by two types of collection and sorting systems in Member States. One model of organising collection and sorting is separation at source. In this system, HHW is broken down into its constituent fractions at the level of the household. These fractions are collected separately and recycled. This system results in a relatively low level of waste collected but with a relatively higher quality.

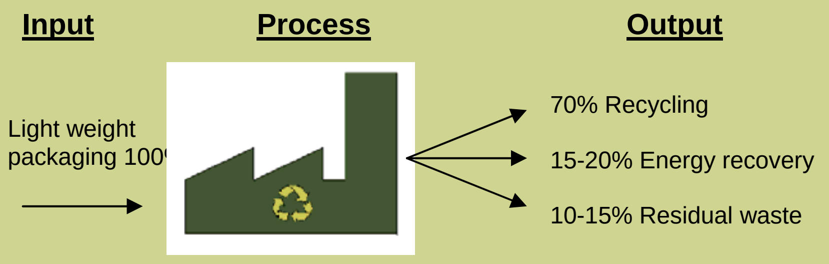
Alternatively, collection and separation may be centralised, i.e. the bulk of HHW is transported from households for processing in sorting facilities to isolate the fractions which are then recycled. This system results in the opposite compared the 'separation at source'-system: the centralised system results in a relatively higher level of waste collected but with a relatively lower quality.

In practice, Member States focus on one of the two collection and sorting systems, or combine them in various proportions.

It is beyond the scope of this study to determine which system is better[26]. However, a central sorting system seems best suited to reach a given target of recycling, even though it may de facto recycle a smaller fraction than the 'separation at source'-system. The reason is that it collects more waste (thereby increasing chance of compliance with the target). However, out of a waste fraction e.g. plastic bottles, a significantly smaller fraction may actually be recycled when the plastic bottles enter the recycling plant collected from a central sorting system compared to if it had been collected from a 'sorting at source'-system. Hence, while a 'sorting at source'-system may often be able to recycle the overwhelming part of the collected waste, the same is not true for wasted collected through a central sorting system, cf. Box 1.

Box 1: Example of recycling from central sorting

In some recycling operations only about 70% of the input waste materials become converted into recyclates (The recycling ratio can be different for different materials, e.g. higher for metals but lower e.g. for plastics) even though all the waste going into the recycling plant will be classified as recycled. The remaining 30% comprises energy recovery and residual waste, cf. the Figure. The case is taken from the Austrian recycling firm Altstoff Recycling Austria AG (ARA).



Note: Only plastic bottles and hollow bodies
Source: ARA (2007)

The residual waste may be classified as waste from industry while is ought to be classified as household or municipal waste if that was indeed the origin of the waste going into the recycling plant.

Source: See in box.

Member States with regulation establishing central sorting of HHW may appear to have the least problems with reaching the 50% target. Germany, Austria, the Netherlands, Belgium are examples of best practice countries with respect to their implementation of central sorting facilities.

The composition of HHW is different

The sizes of the green, yellow and red fractions in HHW differ across Member States, cf. Table 5. The larger the size of the fractions yielding themselves to recycling, i.e. green and yellow, the easier it is to reach the recycling target.

[26] It also depends on local circumstances.

Table 5: Proportion of Municipal Solid Waste, European regions, 2006

	Eastern Europe	Northern Europe	Southern Europe	Western Europe
Paper/ cardboard	22	31	17	28
Food waste	31	24	37	24

Source: Ökopol (2008)

In Northern and Western Europe the content of paper and cardboard in HHW (newspapers and printed matter) is larger than in Southern and Eastern Europe. As the recycling of paper is well established and has positive economic value, a large content of paper waste makes it easier for countries in those regions to reach the recycling target. By contrast, the remaining countries would be more dependent on recycling the more difficult fractions of HHW, for example bio waste in order to reach the target.

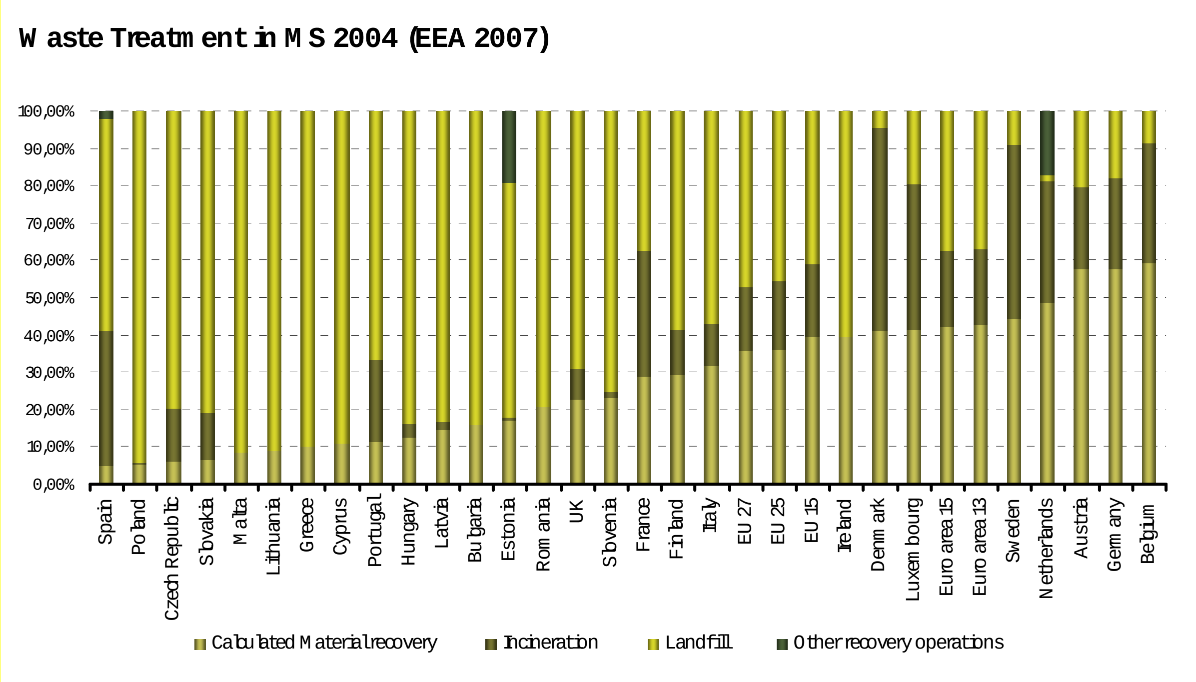
As another example, in Denmark there is a reuse system with deposit on glass packaging for beer and soft drinks. Presence of the system leads to less glass being classified as waste. Less glass in HHW hinders reaching the recycling target as waste glass is a readily recyclable waste. On the other hand, large amounts of garden waste are collected in Denmark. Generally, the collected garden waste is composted which is classified as recycling thus contributing to the target. In countries with more constrained access to garden waste, it will be more difficult to reach the target.

Differences in available treatment technologies

Member States have access to different technologies for treating waste. The amount of capacity for landfilling, incineration and recycling differs. In some countries (e.g. Denmark, Sweden and the Netherlands) HHW including a large amount of biodegradable waste is incinerated. Therefore, new recycling capacity must be established in order to comply with the target, given that incineration with energy recovery is not classified as recycling.

The challenge is even larger for countries currently investing in incineration capacity, which some countries may choose as a technological solution in order to comply with the landfill directive and its prohibition on the landfilling of biodegradable waste. However, examining the available data it becomes evident that a high level of incineration does not preclude high levels of recycling. On the contrary, countries with high incineration capacity (Northern Europe) also tend to be characterized with high rates of recycling and consequently low reliance on landfill, cf. Figure 10. Consequently, high use of incineration is not necessarily in conflict with ambitious recycling targets.

Figure 10: Treatment operations of HHW



Note: Figures for Spain and Estonia are from 2003. Original source is Eurostat Structural Indicators on municipal waste, supplemented with national statistics from Germany, Spain, the Netherlands and Estonia.
Source: EEA (2007)

3.4 Monitoring and enforcement of targets

As with construction and demolition waste, Article 8a of the "Draft legislation resolution" document of the European Parliament requires that the Waste Statistics Regulation (WSR) data is used for monitoring the target on recycling household and similar waste (HHW).

In the case of HHW, the WSR data appears to be better suited for the task than was the case in the previous chapter on construction and demolition waste, however data is not (yet) available to document recycling of HHW. WSR is suitable because HHW is defined as a separate waste stream in the treatment data collected under the European Waste Classification for Statistics (EWC-Stat) which is the level of aggregation of the Eurostat data.

However, there is no data on recovery of HHW. Furthermore, if the data becomes available in the future, it still needs to be determined whether "recovery" is representative of "recycling" which is the objective of the 50 % target for HHW. We discuss these two issues analogously to the discussion in the previous chapter on statistical issues for construction and demolition waste:

- It is possible to identify HHW in the available data in Eurostat.
- There is no data on recovery of HHW at present. Should the data become available, it will be necessary to determine whether "recovery" in the WSR data is representative of "recycling". The discussion is the same as for CDW.

The issues are examined in turn:

3.4.1 The definition of HHW in the available WSR data

The European List of Waste (LoW) does not explicitly define HHW. Chapter 20 of the LoW defines "Municipal wastes" comprising household waste and similar commercial, industrial and institutional wastes including separately collected fractions.

This definition is broader than HHW. However, HHW has been isolated in the EWC-Stat nomenclature, cf. Table 6. Therefore, the available data *does* represent the waste stream for which the 50 % recycling target has been set.

Table 6: Contents of the Eurostat HHW definition

EWC-Stat categories	Availability in Eurostat
EWC_Stat 10 Mixed ordinary wastes	Not available and not required
10.1 Household and similar wastes	← The available data in Eurostat corresponds to the waste stream for which the 50% target has been allocated
10.2 Mixed and undifferentiated materials	Not available, not required
10.3 Sorting residues	Not available, not required

Source: http://ec.europa.eu/eurostat/ramon/other_documents/ewc_stat_3/annex_1_and_3/annex_1_and_3_en.pdf

3.4.2 Availability of recycling as a treatment option for HHW

In the WSR data on Eurostat there is no data available on recovery of HHW waste. Thus, there is no available WSR data to illustrate recycling of HHW. The difficulty in producing data on the availability of recycling of HHW has led the EEA(2007) and EIONET to construct their own estimates using the data available from the Structural Indicators in Eurostat. This data is available for total generation of municipal waste, land filling and incineration as separate treatment options. By subtracting land filling and incineration from total generation of waste the *maximal*, theoretical potential for recycling is derived. However, it is difficult to assess when this approach gives a valid representation of the *actual* amount of recycling undertaken by specific countries. Thus, the data might at best demonstrate whether countries have a large potential for recycling rather than what countries actually do. Hence, interpreting the data processed this way as a proxy for recycling of HHW taking place is very approximate and most likely insufficient for monitoring the recycling target for HHW.

If WSR data on recycling of HHW becomes available in the second wave, the problem of the correspondence between recovery and recycling will remain. The data available in Eurostat under WSR data do not specify “recycling” as a treatment option. Instead, the data specifies “recovery”. Therefore, the issue is whether the recovery operations for which data is available are representative of recycling operations for which the target has been set for HHW. This is essentially the same problem as for CDW, cf. Section 3.3.

As a last issue, recovery data contains imported waste but does not necessarily account for exports.

4. INDUSTRIAL WASTE AND WASTE PREVENTION TARGETS

This chapter briefly discusses setting targets for recycling of industrial and manufacturing waste and prevention of all waste.

While industrial waste is often comprised of large, clean fractions rendering industrial waste suitable for recycling, making use of industrial bi-products is widely applied in industry but not labelled as waste whereby it does not count towards a target. Furthermore, the feasibility and incentives to recycle differs markedly between industries. Some industries simply produce waste that has much more economic value as recyclates than other industries. Hence, the type of industries in a given Member State may be to a large extent determine how easily Member States will reach a target.

Preventing or stabilising waste means decoupling waste generation from economic growth. Some decoupling has occurred over the past 30 years, but it is evident that instruments need to be implemented providing the proper economic incentive through the value chain of a product. This again requires credible measuring of waste generation which is currently not the case.

4.1 Industrial waste target

Below it is presented two lines of argument in relation to setting targets on industrial waste. The first argument has to do with bi-products and the homogeneity of fractions, the second argument has to do with data definitions on industrial waste and recycling.

4.1.1 Bi-products and large fractions

Many industrial processes produce bi-products. Often these bi-products have economic value and are sold to other firms and used as input in their production processes. However, bi-products do not always enter the waste stream and are therefore not registered as waste. Hence, even though good use is being made of what is essentially ‘waste’ from production, its further use will not count towards a recycling target. The trade in bi-products may be significant.

One of the reasons for the significant use of bi-products from industry is that industry waste is often produced in large, well defined fractions which make the waste very suitable for further use and recycling. For example, it is much cheaper to sort compared to household waste.

This essentially implies that setting a target on recycling may be feasible, because the properties of industrial waste make it relatively cheap to recycle. However, ‘recyclability’, the economics of recycling, differs significantly between industries. For example, waste from the graphical industry is easy to recycle and use as input in the paper and pulp industry, metal industry and the chemical industry. This means that Member States which happen to be overrepresented in industries, whose waste is suitable for recycling, will be able to reach a certain target much easier and more cheaply than Member States that are underrepresented in these industries.

4.1.2 Monitoring and enforcement of targets

As in the case of household and similar waste (HHW) and construction and demolition waste (CDW), the “Draft legislation resolution” refers to the Waste Statistics Regulation (WSR) for monitoring the target on industrial waste.

As before, this section looks into the definition of 'Industrial Waste' (IW) and the availability of data on recycling. The main issue, however, is of that of specifying a definition of industrial waste since the WSR does not define IW as a separate grouping in a similar manner to HHW. Due to the heterogeneous nature of the stream it is also more difficult to proceed with an *ad hoc* representation of IW in a manner similar to that suggested by Eurostat for CDW (where Eurostat suggests using Mineral waste). The detailed issues concern the following:

- Definition of IW in the EWC-Stat and the possibility to represent IW using the available data;
- Availability and representativeness of 'recovery' data as 'recycling'.

Definition of Industrial Waste in the EWC-Stat

Currently, the WSR does not define IW as a separate stream and it is not possible to define IW in the WSR data on waste treatment *ad hoc*. In contrast to CDW where the choice of a single EWC-Stat category (Eurostat presents data on EWC-stat level) has been suggested by Eurostat, IW requires an approach more similar to that defining HHW in Annex III to the WSR.

Given that a definition for HHW has actually been constructed, it appears feasible to derive a definition of 'industrial waste' at a similar level, linking it back to the European List of Waste (LoW) by means of a consolidation key or an 'equivalence list' similar to that in Annex III of the WSR. On the other hand, it is today not possible to proceed with an ad hoc choice of a single EWC-Stat category since IW is heterogeneous.

The WSR reports data on a number of separate waste materials (e.g. rubber and chemicals). A number of groupings of these EWC-Stat categories has been constructed, cf. Table 7, but it is not clear which of them should best represent 'industrial waste', if any. They appear to be rather temporary in nature as they are not formally defined either in Annex I or Annex III to the WSR. These, however, show that it should in principle be possible to construct a representation of IW from the available EWC-Stat categories. However, such attempts should be formalized and a single grouping of EWC-Stat categories clearly designated as representative of IW for the purpose of the target.

Table 7: Available groupings of WSR waste treatment data in Eurostat potentially representing IW

The available individual EWC-Stat categories in Eurostat, potentially representing IW	Aggregations of individual waste categories in Eurostat, potentially representing IW
EWC_013 Used oils	EWC_01_TO_03
EWC_05 Health care and biological	EWC_01_TO_03_NOT_013
EWC_06 Metallic wastes	EWC_09_NOT_0911_093
EWC_071 Glass wastes	EWC_T_01_02_03_05_08_10_11_13
EWC_072 Paper and cardboard wastes	EWC_T_01_TO_05_075_077_08_10_11_13_NOT_013
EWC_073 Rubber wastes	EWC_T_05_TO_08_13
EWC_074 Plastic wastes	EWC_T_06_TO_09_12_13
EWC_075 Wood wastes	EWC_T_06_TO_09_12_13_NOT_077
EWC_076 Textile wastes	
EWC_077Waste containing PCB	

Note: The descriptions of the aggregations combine the names of the individual EWC-Stat categories from the left column. It is not clear which, if any, should be used to represent IW.

Source: WSR data in Eurostat, http://epp.eurostat.ec.europa.eu/portal/page?_pageid=0,1136239,0_45571447&_dad=portal&_schema=PORTAL

Availability and representativeness of 'recovery' data as 'recycling'

As before, the available treatment definition in the WSR is 'recovery' as defined in Annex IIB Recovery operations to the framework directive, rather than 'recycling'. The recovery definition comprises about 90% of operations that can be classified as recycling operations. In other words, it is broader than recycling. In the case of the remaining 10% it is not clear whether they are recycling. The possibilities are reuse, land treatment and others[27]. Note that the definition of recovery in Annex IIB includes energy recovery which is not recycling. The WSR, however, presents energy recovery separately from recovery. In principle, the issue of the representativeness of the available recovery data for recycling is identical to that concerning HHW and CDW.

Examining the individual EWC-Stat categories for availability of data, there is a rather mixed picture. Data for some EWC-Stat appears to be rather well available for the EU27 countries, while data is systematically missing in all countries for other categories. The systematic lack of data will be a problem when constructing a definition of IW based on an aggregation of EWC-Stat categories. In other words, the aggregated IW data may not be comparable between countries if different EWC-Stat categories are available for different countries – the composition of IW may differ between countries.

Another issue is that of the potentially more hazardous nature of industrial waste than both household and similar waste and construction and demolition waste. Therefore, it would appear of advantage to consider the distinction between hazardous and non-hazardous industrial waste data availability. Adding the hazardous dimension, however, would imply even more challenges with obtaining a consistent representation of IW across Member States, due to missing data.

As a last issue, recovery data contains imported waste but does not necessarily account for exports.

4.2 Prevention of waste target

The European Parliament considers setting a target for prevention of waste such that the level of waste generated in 2012 should not supersede the level of waste generated in 2009.

Setting a target on overall generation (not recycling) of waste may not be enough to stabilise waste generation. In the Commission's Fifth Environment Action Programme (adopted on 18 March 1992), the Commission set a target of stabilising (municipal) waste production in 2000 at the 1985 level of 300 kg per capita of the population, but the target was not attained.

The historical experiences with preventing waste generation demonstrate the inherent difficulty of decoupling waste generation from economic growth: the more goods produced, the more waste generated. However, the OECD suggests that decoupling has in fact occurred over the past 30 years in the sense that (municipal) waste generation has grown at a slower rate than private consumption, looking at all OECD countries[28]. Nevertheless, compared to the 1985 level of 300 kg per capita, OECD estimates the current amount of municipal waste generated to be almost twice that.

It is evident that such a target on waste prevention can only be reached if Member States introduce instruments providing the proper economic incentives for waste prevention. Such instruments were not introduced following the target in the Commission's Fifth Environment Action Programme.

[27] See Annex IIB of the waste framework directive for details. http://waste.eionet.europa.eu/definitions/recovery
[28] See http://www.oecd.org/dataoecd/20/40/37551205.pdf.

In addition to providing proper economic incentive, instruments must tackle waste generation throughout all parts of the value chain of a product. This also includes the design phase and the marketing phase. That is, parts of the value chain that is not directly linked to final waste generation and traditional waste management.

Furthermore, Member States experiencing strong economic growth may have a harder time complying with a stabilisation target compared to Member States experiencing a slower economic growth. The new Member States are expected to experience stronger growth due to an effect of 'caching up' with the old Member States.

Finally, monitoring and enforcing a target on waste generation requires clear measuring and monitoring of waste generation. The previous chapters clearly indicate that several challenges exist on measuring waste generation. Before these challenges are resolved, it does not seem clear how Member States can introduce effective instruments throughout the value chain leading to less generation of waste.

5. CONCLUSIONS

This chapter presents the overall conclusions of the assessment.

5.1 Targets on HHW and CDW seem feasible but compliance costs may differ

The research has showed that 50% recycling of household and similar waste and 70% of construction and demolition waste seem feasible to reach. For both targets, evidence suggests that some Member States today are already complying with the targets.

For both household and similar waste and for construction and demolition waste recyclable fraction exists that add up to above the target threshold. However, the story differs between the two types of waste.

On the one hand, almost all of construction and demolition waste has the potential to be recycled. For example, Denmark recycles around 95% of all its construction and demolition waste.

On the other hand, out of household and similar waste, only roughly 75% on EU level is likely to ever be considered to be recycled which makes a 50% target an ambitious one. Out of the 75%, bio waste (food waste, garden waste and similar) represents half. Hence, bio waste needs to be recycled in order to comply with the target. Furthermore, out of the 75% which may be recycled, it will always be very costly to recycle the ‘last percentages’.

It will not be equally easy for all Member States to reach the targets because of differences in local conditions.

Regarding construction and demolition waste, for countries with easy access to virgin materials and where distances for transporting recyclates will often be large, the incentive to recycle is low. This means that a large regulatory or fiscal incentive to recycle is necessary. As this could lead to increased incentive for firms to e.g. illegal dumping of waste, enforcement has to be strengthened. For countries in the opposite situation - virgin materials are expensive and transportation costs of recyclates are low – the incentive to recycle is much stronger. Consequently, only a small regulatory or fiscal incentive to recycle may be necessary for firms to recycle.

Regarding household and similar waste, Member States that have historically chosen a road of central sorting of waste seem to stand a better chance of reaching the target than countries that has chosen a road of sorting at the individual household level. Central sorting generally results in more recyclable waste being collected compared to sorting at the household level. Furthermore, composition of household and similar waste differs between Member States. For some Member States easily recyclable waste fractions such as paper may represent a significantly larger share compared to other Member States allowing the former Member States to more easily reach the target.

5.2 Setting targets may impact other environmentally based goals

The Landfill Directive seeks to reduce amount of waste being land filled. This is conducive to reaching the target on construction and demolition waste because recycling of this waste is about the only alternative to land filling (incineration of construction and demolition waste is not a real option). For household and similar waste, the same holds true for the packaging directive which sets goals on recycling of packaging waste which is covered by household and similar waste.

However, the target on household and similar waste may work against incentives provided in the Landfill directive. The reason is that some countries might choose to comply with the Landfill directive through the building of new incineration capacity instead of recycling – this is a valid option in the Landfill directive. But incineration does not count as recycling in the current context.

Not including incineration with energy recovery (means that electricity is produced from incinerating waste) in the target for household and similar waste may not directly support another EU goal: reaping an increasing amount of electricity from renewable sources.

Incineration with energy recovery is sometimes more environmentally beneficial than recycling. This is for example the case for bio waste where composting is regarded as recycling. But the environmental benefits are smaller than those obtained through incineration with energy recovery or gasification where bio waste is first converted into biogas (and compost) which is then used to produce electricity.

5.3 Data is not yet in place

Having discussed the possibility of recycling a large amount of waste generated from construction and demolition and households, it is crucial to assess whether or not credible targets can be set. The following three points are essential:

First, current data and statistics on waste generation are not in place for setting targets. It is simply not yet clear what types of waste are covered by construction and demolition waste and household and similar waste. Setting a target based on the current statistical regulations is likely to produce discussions on which types of waste and what treatment operation should count towards the targets. For example, 'Construction and demolition waste' is not a defined entity in Eurostat. The closest is mineral waste, which, however, covers other waste streams in addition to construction and demolition waste. Generation of household and similar waste is in principle available in Eurostat, but it is not *de facto* available for all Member States.

Second, the current waste statistics often loose the origin of waste when treatment options (e.g. recycling, incineration) are covered: while treatment operations on waste fractions such as paper and glass are well defined and measured, the economic activity producing the waste fraction which is being treated is often missing. Ideally, a matrix of waste fractions down the one axes and economic activity (by NACE categories) across the other axes ought to be in place before targets can be set. Furthermore, data on 'recycling' is not available in Eurostat. Only 'recovery' is available. The same holds for construction and demolition waste. The extent to which recycling and recovery overlap, is unclear.

Third, imports and exports are not properly accounted for in the waste statistics. For example, 'recovery' in Eurostat includes recovery from imported waste but does not specify what share is imported. Export is generally not accounted for in the waste statistics at all.

5.4 Difficult to set target on industrial waste

The European Parliament considers setting a target for industrial waste. The issue of lack of information on how to define industrial waste seems even more pronounced for industrial waste than for construction and household waste. While specific waste fractions which are likely to be generated in the industry (e.g. metallic waste and rubber waste) is specified, knowledge on the specific industry responsible for the waste generated is not available. As is the case for household and similar waste and construction and demolition waste, information on the treatment operation of 'recycling' is unavailable in Eurostat. The closest is 'recovery'.

Therefore, it might be less advisable at this stage to set targets as there is simply very little knowledge of what waste originates from industry and the share of waste recycled from specific industries.

Another aspect of data and definitions of waste concerns the issue of bi-products. Many industrial processes produce bi-products. Often these bi-products have economic value and are sold to other firms and used as input in their production processes. However, bi-products do not always enter the waste stream and are therefore not registered as waste. Hence, even though good use is being made of what is essentially ‘waste’ from production, its further use will not count towards a recycling-target. Trade in bi-products may be significant.

5.5 Prevention of waste requires much more than waste management

The European Parliament considers setting a target for prevention of waste such that the level of waste generated in 2012 should not supersede the level of waste generated in 2009.

Setting a target may not be enough to stabilise waste generation. In the Commission's Fifth Environment Action Programme, the Comission set a target of stabilising waste production in 2000 at the 1985 level of 300 kg per capita of the population, but the target was not attained.

The historical experiences with preventing waste generation demonstrate the inherent difficulty of decoupling waste generation from economic growth: the more goods produced, the more waste generated. However, the OECD suggests that some degree of decoupling has in fact occurred over the past 30 years.

It is evident that a target on waste prevention can only be reached if Member States introduce instruments providing the proper economic incentives for waste prevention. Such instruments were not introduced following the target in the Commission's Fifth Environment Action Programme. In addition to providing proper economic incentive, instruments must tackle waste generation throughout all parts of the value chain of a product. This also includes the design phase and the marketing phase. That is, parts of the value chain that is not directly linked to final waste generation and traditional waste management.

Furthermore, monitoring and enforcing a target on waste generation requires clear measuring and monitoring of waste generation. The previous conclusions on lack of knowledge and waste generation, including data on import and exports, clearly indicate that several challenges exist on measuring waste generation in the specific parts of the economy. Before these challenges are resolved, it does not seem clear how Member States can introduce effective instruments targeting various economic activities, which is, nevertheless, what seems necessary in order to stabilize generation of waste.

5.6 Implications and recommendations

This study shows that statistical data and definitions are not yet in place for setting a target on construction and demolition waste and household and similar waste. This should, naturally, be in place prior to setting targets.

Based on the difficulties of defining what exactly is and is not covered by what definitions, we point to the possibility of alternative targets:

- Set recycling targets on specific fractions such as paper, plastic and bio waste. Alternatively:
- Set recycling targets on all waste irrespective of origin; this would automatically cover industrial waste.

Both suggestions strongly reduce the problems of definitions (generated waste by fractions are better defined than generated waste by economic activity) and of origin (fractions can be identified throughout the waste management process, while the economic activity that generated the waste is often lost).

It seems fruitful to discuss whether or not incineration with energy recover should not in some instances be put on the same footing as recycling; those instances should be where incineration produces greater environmental benefit than recycling.

Finally, it is important to design framework conditions to allow Member States to reach targets in a least cost way. For example, further promotion of trade in waste and perhaps the introduction of tradable certificates on recycling could help to reduce Member States' compliance costs.

BIBLIOGRAPHY

ARA (2007)	ARA (2007) Sustainable and efficient Waste Management -Experiences from Austria, PPT-document , http://www.renosam.dk/media/filebank/org/ARA.pdf
Com (2005)	Com (2005) 667 final; Proposal for a Directive of the European Parliament and of the Council on waste; http://ec.europa.eu/environment/waste/pdf/directive_waste_en.pdf
Com (2000)	Commission Decision 2000/532/EC of May 3, http://www.netregs.gov.uk/commondata/acrobat/ewc.pdf?lang=_e
Com (2001)	DG Enterprise and Industry, http://ec.europa.eu/enterprise/construction/suscon/tgs/tg3/demfin.htm
Cowam (2006)	http://www.cowam-project.org/cms/Content/download/Construction%20and%20Demolition%20Waste%20Management%20in%20Germany.pdf
DTU (2007)	Vestforbrænding/DTU (2007), LCA af dagrenovationssystemet i syv nordsjællandske kommuner, Institut for Miljø og Ressourcer: Danmarks Tekniske Universitet
EEA (2002)	Europen Environment Agency (2002), Review of selected waste streams: Sewage sludge, construction and demolition waste, waste oils, waste from coal-fired power plants and biodegradable municipal waste, EEA
EEA (2007)	European Environment Agency (2007), The road from landfilling to recycling: common destination, different routes, Copenhagen Luxembourg: Office for Official Publications of the European Communities, eea.europa.eu
Eionet (2006a)	Eionet (2006); European Topic Centre on Resource and Waste Management (2006) Country fact sheet: ALL COUNTRIES
Eionet (2006b)	Eionet (2006)Waste; http://waste.eionet.europa.eu/definitions/waste
Eionet (2006c)	Einoet (2006) Wastebase; http://waste.eionet.europa.eu/facts/wastebase
Eionet (2008)	Eionet (2008) What is waste?; http://waste.eionet.europa.eu/themes/waste/#4
Environmental Agency (2004)	Environmental Agency (2004) Hazardous Waste and Contaminated Soil; www.environment-agency.gov.uk/commondata/103599/hwcl_qa_v.1_844475.doc
EP (2002)	Regulation (EC) No 2150/2002 of the European Parliament and of the Council of 25 November 2002 on waste statistics, Official Journal of the European Communities; http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2002:332:0001:0036:EN:PDF
Eurostat;	ANNEX III of the WSR; Eurostat http://ec.europa.eu/eurostat/ramon/other_documents/ewc_stat_3/annex_1_and_3/annex_1_and_3_en.pdf ; Commission Regulation (EC) No 574/2004of 23 February 2004 amending Annexes I and III to Regulation (EC) No 2150/2002 of the European Parliament and of the Council on waste statistics
Eurostat,	WSR data http://epp.eurostat.ec.europa.eu/portal/page?_pageid=0,1136239,0_45571447&_dad=portal&_schema=PORTAL
Eurostat	http://ec.europa.eu/eurostat/ramon/other_documents/ewc_stat_3/index.cfm?TargetUrl=DSP_EWC_STAT_3
KARA (2007)	KARA/NOVEREN (2007), Miljøøkonomisk undersøgelse i Holbæk, Kalundborg og Odsherred Kommuner, Rambøll Danmark
OECD (2007)	Environmental Data COMPENDIUM 2006/2007
Okopol (2008)	Okopol (2008), CLIMATE PROTECTION POTENTIALS OF EU RECYCLING TARGETS

Tsiliyannis (2006)	Tsiliyannis (2006): *Flexible enviromental reuse/recycle policy based on economis strength*, Waste Management 27, 2007, 3-12.
Vestforbrænding (2007)	Vestforbrænding (2007), Vurdering af miljømæssige og økonomiske konsekvenser for fremtidige affaldsordninger, Vestforbrænding
WRAP (2006)	Waste & Resources Action Programme (2006), Environmental benefits of recycling-An international review of life cycle comparisons for key materials in the UK recycling sector.
Miljøstyrelsen (1999)	(Danish Environmental Protection Agency) Waste 21; Appendix C capacity; http://glwww.mst.dk/udgiv/Publications/1999/87-7909-571-2/html/bilag03_eng.htm
EP (2008)	Recommendation for Second Reading, on the Council common position for adopting a directive of the European Parliament and of the Council on waste, (11406/4/2007 – C6 0056/2008 – 2005/0281(COD)), Committee on the Environment, Public Health and Food Safety
Council (2007)	Directive 2007/…/EC of the European Parliament and of the Council of on waste and repealing certain Directives