Better management of municipal waste will reduce greenhouse gas emissions

Supporting document to EEA Briefing 2008/01

Key Messages:

The amount of municipal waste per year is expected to grow by 25% within the European Union from 2005 to 2020, with striking differences arising between Member States.

The implementation of European and national waste management policies, which aim to increase recovery of waste and divert waste away from landfill, plays a key role in tackling the environmental impacts of increasing waste volumes.

As recycling and incineration with energy recovery are increasingly used, net greenhouse gas emissions from municipal waste management are expected to drop considerably by 2020.

There are limits to the extent that Europe can rely on improved waste management practices to tackle unsustainable consumption and production patterns and the waste-related greenhouse gas emissions.

The European policy framework

Waste management is one of the key priorities of EU environmental policy and the framework in this area has been progressively put in place since the 1970s. However, as the European Commission has made clear, this framework 'is only the backbone of waste management practice. It necessarily needs complementary action by Member States and local authorities' (EC 2003, p. 12). The amended Waste Framework directive, final adoption of which is expected by 2009, will be an important step towards further coordinating efforts in this area.

The Sixth Environment Action Programme (2002-2012) set the level of ambition for the further evolution of European waste management policy when it called for: a decoupling of environmental pressures from economic growth, and a significant reduction in (i) volumes of waste generated, (ii) quantity of waste going to disposal (i.e. landfill or incineration with no or low rates of energy recovery), and (iii) volumes of hazardous waste produced. This level of ambition was repeated in the European Commission's proposed Thematic Strategy on Prevention and Recycling (2005), when it stated that: 'The long-term goal for the EU is to become a recycling society that seeks to avoid waste and uses waste as a resource'.

Over the course of the period since the Sixth Environment Action Programme was adopted, Europe's leadership on policies to tackle climate change has strengthened. The then fifteen EU Member States (EU-15) agreed under the Kyoto Protocol to a 8% reduction of total green-

house gas (GHG) emissions by 2008-2012 from base year, while the twelve Member states which joined the EU in 2004 and 2006 (EU 12) have individual reduction targets. In 2005, greenhouse gas emissions from waste management represented about 2% of the total emissions in the European Union (EEA 2007c).

There is a growing awareness among policy-makers and scientists of the interface between waste management policies and policy to tackle climate change. Methane is one of the six greenhouse gases controlled by the Kyoto Protocol and methane emissions are especially linked to agriculture (particularly cattle) and landfill operations. The EU Landfill Directive (1999) can therefore help in achieving EU targets on GHG emissions reductions, for example through methane recovery and diversion of biodegradable municipal waste from landfill. Another interface between waste management and climate change policies is the consumption of energy (giving rise to greenhouse gas emissions) in the collection, treatment and manufacturing use of waste.

The present document reports on latest outlooks from the European Environment Agency and its European Topic Centre on Resource and Waste Management (ETC/RWM) on municipal waste management and the related GHG emissions. Past, current and planned legislative tools are considered when developing projections.

The amount of municipal waste is expected to grow by 25% within the European Union from 2005 to 2020, with striking differences arising between Member States.

Waste generation trends are driven by several factors, such as economic activity, demographic changes, technological innovations, life-style and patterns of production and consumption. It is clear, however, that municipal waste volumes are on the rise.

On average, each European citizen generated 460 kg municipal waste in 1995. This amount rose to 520 kg per person by 2004, and a further increase to 680 kg per person is projected by 2020. In total, this corresponds to an increase of almost 50% in 25 years. This projected continuing increase in waste volumes is primarily due to an assumed sustained growth in private final consumption (i.e. an average growth in the EU-15 and EU-12 respectively of 2% and 4% per year by 2020, EC 2006) and a continuation of current trends in consumption patterns.

However, as shown in Figure 1, there are significant differences between EU-15[1] and EU-12[2] Member States. While an EU-15 citizen generated 570 kg on average in 2004, the figure was only 335 kg for an EU-12 citizen. Nevertheless, as EU-12 economies further develop and consumption patterns evolve, waste volumes are likely to increase over the next 15 years and approach current EU-15 levels. Looking forward, municipal waste volumes within the EU-15 and EU-12 are expected to grow 22% and 50% by 2020, respectively. Over the entire period, more than 80% of the total municipal waste is generated in the EU-15.

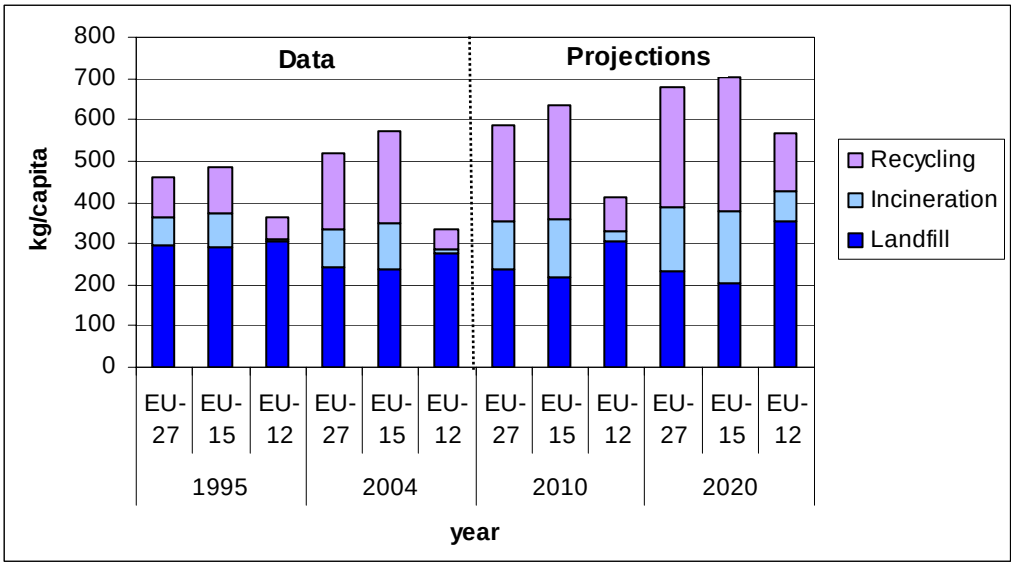
[1] Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, United Kingdom

[2] Bulgaria, Czech Republic, Cyprus, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovenia, Slovakia

If we were simply to spread all EU municipal waste generated in 2020 (i.e. about 340 million tonnes) on the ground, it would cover an area the size of Luxembourg 30 cm thick or Malta 2.5 m thick!

These results indicate that efforts to prevent the generation of waste should be significantly reinforced, if the aim of the Sixth Environment Action Programme of a significant reduction in volumes of waste is to be achieved.

Figure 1. Generation and management of municipal waste in Europe (per capita)



Source: Eurostat and ETC/RWM

The implementation of European and national waste management policies, which aim to increase recovery of waste and divert waste away from landfill, plays a key role in tackling the environmental impacts of increasing waste volumes.

Current EU waste policy is based on the so-called waste hierarchy. This means that, ideally, waste generation should be prevented or reduced, and that which is generated should be recovered by means of re-use, recycling and other recovery operations, thus reducing disposal operations. In municipal waste management, landfilling of untreated waste is generally the worst option for the environment because of its emissions of methane, its long-term emissions to soils and groundwater as well as the loss of resources it entails. The position of waste incineration in the hierarchy is a subject of intense debate under the review of the Waste Framework Directive (2006). However, it is clear that its position in the hierarchy is more favourable if incineration is combined with high rates of energy recovery and strict emission controls are met.

Historically, disposal by landfilling has been the predominant treatment method for municipal waste but over the last two decades considerable reductions in landfilling have taken place. In 2004, 47 % of total EU municipal waste was landfilled (see Figure 1); this is expected to decrease further to around 35% by 2020. Recycling and other material recovery operations are expected to increase from the current level of 36% to around 42% by 2020. Finally incineration was used for 17% of municipal waste in 2004 and is likely to increase to about 25% by 2020.

These past and expected trends are in part the result of dedicated policies which aim to increase the recycling and recovery of packaging waste (e.g. 1994 Packaging Directive) and to divert biodegradable municipal waste away from landfill (e.g. 1999 Landfill Directive). Overall, a further reduction of the quantity of municipal waste going to landfill is projected, which reflects the efforts made at national and European levels to achieve, among other things, the objectives set in the Sixth Environment Action Programme.

An EEA publication (EEA, 2007b) illustrates patterns in Member States approaches to waste management, particularly in the context of the Landfill directive.

As recycling and incineration with energy recovery are increasingly used, net greenhouse gas emissions from municipal waste management are expected to drop considerably by 2020.

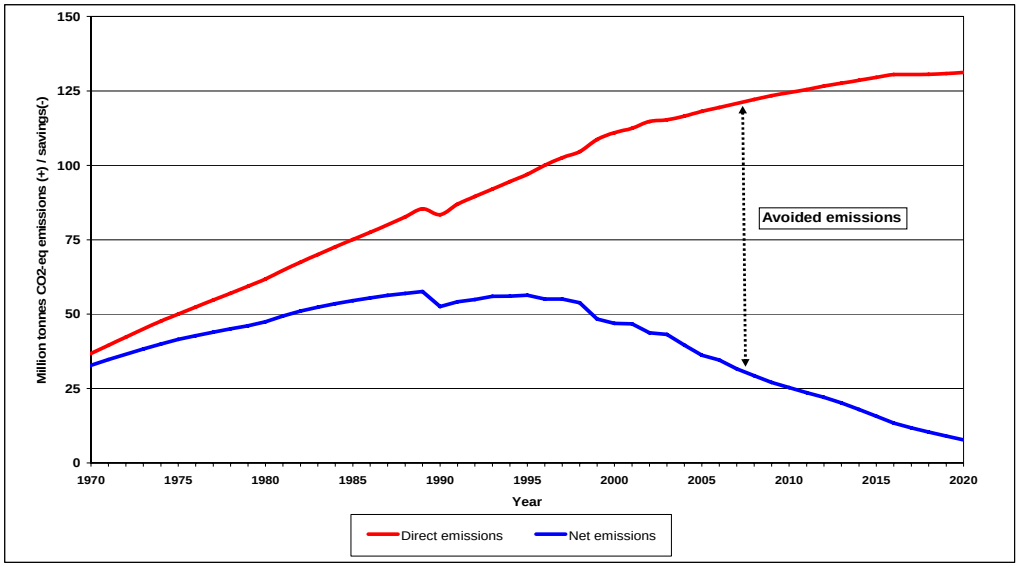
Net emissions of greenhouse gases from the management of municipal waste are projected to decline from a peak of around 55 million tonnes CO_2-equivalents per year in the late 1980s to 10 million tonnes CO_2-equivalents by 2020 (Figure 2).

This is due to two separate developments. On the one hand, waste quantities that enter management facilities are projected to continue to grow as waste generation per capita increases and waste collection is further improved. This pushes direct emissions of greenhouse gases from the waste management sector up. Landfilling represents 60% of the total in 2020, and recycling and incineration about 20% each.

On the other hand, recycling and incineration are increasingly being used and this is projected to continue. This represents savings (or avoided greenhouse gas emissions). As far as greenhouse gases emissions are concerned, the environmental benefits of recycling and incineration outweigh their environmental impacts and those of landfilling and transport of waste. Recycling contributes 75% of total avoided emissions by 2020 and incineration almost 25%.

Overall therefore, the projections show that better management of municipal waste will reduce greenhouse gas emissions in Europe, decoupling environmental pressures from economic growth as called for in the Sixth Environment Action Programme. Furthermore, with an expected further development of recycling and waste being increasingly used as a resource, the projections point towards achieving the long-term goal of becoming a recycling society as stated in the Thematic Strategy on Prevention and Recycling.

Figure 2. Trends and projections of GHG emissions from management of municipal waste in the European Union



Source: ETC/RWM

Note to Figure 2 - On the Y-axis, the positive section represents direct emissions, e.g. methane emissions from landfills or CO2 emissions from incineration, recycling and waste collection; the negative section represents the avoided emissions due primarily to recycling of secondary materials and incineration of waste. Life-cycle information allows calculating these avoided emissions or 'savings' that represent the benefit of recycling and incineration for manufacturing products (e.g. plastics, paper and metals) and producing energy instead of using fossil fuels and raw materials. Landfilling also contributes to avoided emissions when methane is recovered and used as an energy source substituting fossil fuels.

The results reported above are based on the 2006 IPCC guidelines, which are used to model emissions for each EU-27 Member State. Note that national projections to 2010 (as reported to the UNFCCC; see EEA 2007c) are using different rates of methane recovery from landfills. The EEA will be discussing this with the countries in dedicated forums.

There are limits to the extent that Europe can rely on improved waste management practices to tackle unsustainable consumption and production patterns and the waste-related greenhouse gas emissions.

The projected decreases in net greenhouse gas emissions in some countries may be jeopardised by the pace of rising waste volume. In the medium to long term, increasing waste quantities may indeed lead to insufficient management capacity (i.e. saturation), hence potentially increasing GHG emissions due to inefficient management. In addition, the cost to society can increase significantly as collecting and treatment of waste are particularly onerous and generating waste is by definition a loss of resources. Finally, waste impacts the environment beyond greenhouse gas emissions, and this is exacerbated by increasing waste volumes.

The collection and transport of waste are estimated to account for less than 5% of direct greenhouse gas emissions of the waste sector, primarily due to the short distances over which municipal waste is usually transported. However, from a broad environmental perspective, the consideration of pressures such as particles emissions, noise or accidents would certainly change this impacts assessment.

In conclusion, Europe cannot become complacent with regard to the continuing growth in waste - reflecting our current unsustainable consumption and production patterns - as this in

the long term may outweigh the improvements taking place in the waste management sector. Consequently, there are limits to the extent that Europe can rely on improved waste management practices to tackle unsustainable consumption and production patterns and the waste-related greenhouse gas emissions.

Annex: Assumptions, Methodology and Uncertainties

Economic development assumptions
The economic outlook used in this work has been developed by the European Commission (EC 2006). It provides an energy and transport reference case to 2030, which represents current trends and policies as implemented in the Member States up to the end of 2004. The EU-wide modelling tool used for projecting municipal waste generation is based on the development in private final consumption.

Life cycle information
Life cycle information, taking into account environmental information across different phases of the waste management chain, allows the European Environment Agency to assess net environmental impacts of waste management.

A life-cycle approach makes it possible to calculate the environmental impacts from different phases of the waste management chain. Life cycle information includes the emissions and consumption of resources related to a product, service or system over their entire lifetime. It goes back as far as the extraction of raw materials and takes into account the upstream processes, such as manufacturing and transport, which take place before end use. In this work, the life-cycle approach focuses on GHG emissions, which are one of the environmental pressures.

The net GHG emissions are calculated as the direct emissions from waste management (e.g. methane emissions from landfills, CO2 emissions from incineration) minus the avoided emissions from material recycling and energy recovery. Using the current energy mix, life cycle information allows calculating the benefits (or avoided emissions) of manufacturing primary materials (e.g. plastics, paper and metals) and producing energy. Landfilling also contributes to avoided emissions when methane is recovered and used as an energy source substituting fossil fuels.

For example, the direct emissions from recycling of paper is based on life cycle data on collection, sorting, de-inking, pulping etc., including the use of energy and auxiliaries for these processes. The benefits are calculated on the basis of life cycle data on production of newspapers, copy paper and cardboard from wood.

The net emissions of greenhouse gases from the waste sector may be negative when a country promotes largely recycling and incineration over landfilling, and exhibits a moderate growth in waste volumes. This means that an effective management of waste can partly offset the emissions that occurred when the raw materials and products were extracted and manufactured, either domestically or internationally, and alleviate those from other sectors (e.g. energy, manufacture, agriculture). For example, it is estimated that Germany has reduced its landfill rate from about 45% in 1995 to 25% in 2004 through a diversion to alternative management options and has had negative net emissions from the waste sector since 2000.

IPCC methodology
The methodology used for the estimation of GHG emissions follows the so-called 'IPCC Guidelines', which are GHG estimation procedures produced by international expert groups for the Intergovernmental Panel on Climate Change (IPCC) and are followed by most Kyoto signing countries to estimate their national yearly GHG emissions. The 2006 IPCC guidelines have been used consistently by the EEA-ETC/RWM for all EU-27 Member States.

Greenhouse gases (GHGs) from the waste management sector include carbon dioxide (CO2), methane (CH4) and nitrous oxide (N2O). Greenhouse gas emissions are reported in terms of CO2-equivalents, where the global warming potentials of methane (a major constituent of landfill gas) and nitrous oxide is respectively 21 and 310 times more powerful than CO2.

The method of methane emissions from landfills includes a time-lag: biodegradable waste landfilled today may start to emit methane gas next year, reach a peak in 4-10 year's time, and prolong the emissions for up to 50-60 years. In addition, the maximum recovery ratio of landfill methane has been set to 20%, following the recommendations of these guidelines and the advice from international experts in the field.

Overall, the calculations include a large number of assumptions. For example, time series on actual waste generation and management are relatively short (approx 10 years). Moreover, recycling quantities have been estimated as the difference between the total amount generated and the volumes landfilled and incinerated.

EU Member States report their direct past and projected greenhouse gas emissions from waste management to the European Commission and the UNFCCC. The EEA produces an annual report which analyses these trends and projections (EEA 2007c).

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