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European Environment Agency

Municipal waste management in Denmark

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Context
The Topic Centre has prepared this working paper for the European Environment Agency (EEA) under its 2012 work programme as a contribution to the EEA's work on waste implementation.

Contents

Highlights

- The overall treatment of MSW in Denmark is characterised by low amounts of landfilling (4 %) and high amounts for incineration (54 %) in 2010
- Denmark was close to 50 % recycling of MSW in 2009. However, the recycling percentage decreased from 2009 to 2010. The main reason for this seems to be the change in the scope of municipal waste due to the new regulation on recyclable waste from enterprises. Therefore it will require an increased effort to reach a 50 % recycling level by 2020 based on 2010 data
- The major initiatives to improve MSW in Denmark were taken before 2001, i.e. landfill ban, landfill and incineration tax, separate collection schemes.

1 Introduction

1.1 Objective

Based on historical MSW data for Denmark and EU targets linked to MSW, the analysis undertaken includes:

- The historical performance on MSW management based on a set of indicators;
- Uncertainties that might explain differences between the countries' performance which are more linked to differences of what the reporting includes than differences in management performance;
- Relation of the indicators to the most important initiatives taken to improve MSW management in the country; and
- Assessment of the future possible trends and achieving of the future EU targets on MSW by 2020.

2 Denmark's MSW management performance

Danish waste management has progressed in leaps and bounds from its initial focus on the protection of human health, through the integration of environmental protection, to the extraction and recovery of resources in waste. This transformation has occurred thanks to a dedicated and thorough policy regime that draws in key actors and assigns clear responsibilities.

In the 1970s, landfilling and dumping of waste on sites lacking any kind environmental protection was still the most common waste disposal practice in Denmark. Landfill was still so common in the 1980s that the landfill capacity was exhausted in the Copenhagen region.

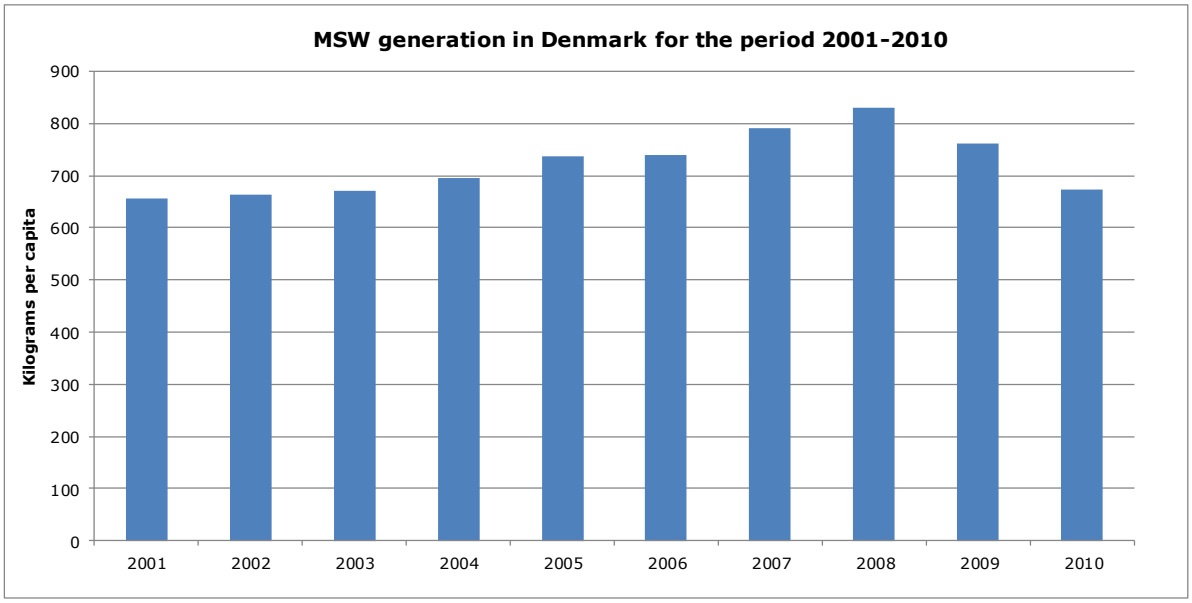
The generation and disposal of waste in Denmark was first mapped in 1985. This showed that 39 % of all waste and 33 % of household waste ended in landfills. This percentage was reduced for household waste to 19 % by 1995 and to 4 % by 2008, while recycling and incineration has simultaneously increased; waste is now seen as a resource to be recovered. As a consequence, many landfills receive so little waste that it is no longer economically viable to keep them fully operational (ETC/SCP, 2012, Fischer et al., 2012).

The first national Waste Plan was developed in 1992, covering the period 1993-97. It included targets for all waste concerning recycling, incineration and landfilling (Fischer et al., 2012). Since then two plans covering the period 1998-2004 and 2005-2008 were developed and implemented. The current plan, the 'Danish Waste Plan 2009-2012', is the fourth national waste plan.

2.1 MSW Indicators

Management of MSW in Denmark is characterized by a high degree of incineration, amounting to 54 % in 2010. It is the highest percentage and the highest amount per capita in EU-27 (Eurostat, 2012).

Figure 2.0 MSW generation per capita in Denmark



Source: Eurostat, 2012

Denmark defines municipal waste as all waste from households as this waste is always collected by a municipal collection scheme and in addition fractions similar to household waste from the primary source 'Institutions, Commerce and Offices' as these fractions are also collected by a municipal scheme in Denmark (Marcher, 2005).

The generation of MSW in Denmark (Figure 2.0) topped in 2008 with 830 kg/capita and has since decreased to 762 kg/capita in 2009 and to 673 kg/capita in 2010 based on Eurostat data. It is important to notice that the data for 2010 are estimates based on the 2009 data (Møller 2012, personal communication). The 2010 data have not yet been released by the Danish Environmental Agency. The reason is the introduction of a new data reporting system in 2010, which required more validation than expected.

The larger decline of 12 % in MSW generation per capita from 2009 to 2010 (Figure 2) is due to change in the waste regulation per 1 January 2010 (Statutory order on waste 2010), which changed the definition of waste regarded as MSW. All enterprises are responsible for recycling of their recyclable waste under the new regulation. In the past, the municipalities had more duties and authorities regarding recyclable waste from private enterprises. The change in regulation resulted in the municipalities no longer having responsibility for ensuring that sufficient recycling capacity is available either at publicly or privately owned plants for waste from institutions, commerce and offices.

The 2009 MSW data showed a total 4 206 000 tonnes, of which 3 437 000 tonnes was household waste and 769 000 tonnes was municipal waste from the service sector 'Institutions, Commerce and Offices'. The estimated data reported to Eurostat for 2010 is based on the 2009 data. However, due to the change in the waste regulation it is assumed that 474 000 tonnes of waste from the service sector collected for recycling is no longer the municipalities' responsibility and is therefore outside the scope of municipal waste (Møller 2012, personal communication).

2.1.1 The recycling of MSW from 2001 to 2010

Figure 2.1 shows the development of recycling of MSW in Denmark related to total recycling, material recycling and organic recycling (compost and other biological treatment). Figure 2.1

illustrates a positive trend in the recycling of MSW from 2001 to 2009. The total recycling increased from 36 % in 2001 to 49 % in 2009. However, the level of recycling decreased to 42 % in 2010.

The decrease from 2009 to 2010 is explained by the change in the scope of municipal waste due to the new regulation on recyclable waste from enterprises as explained above.

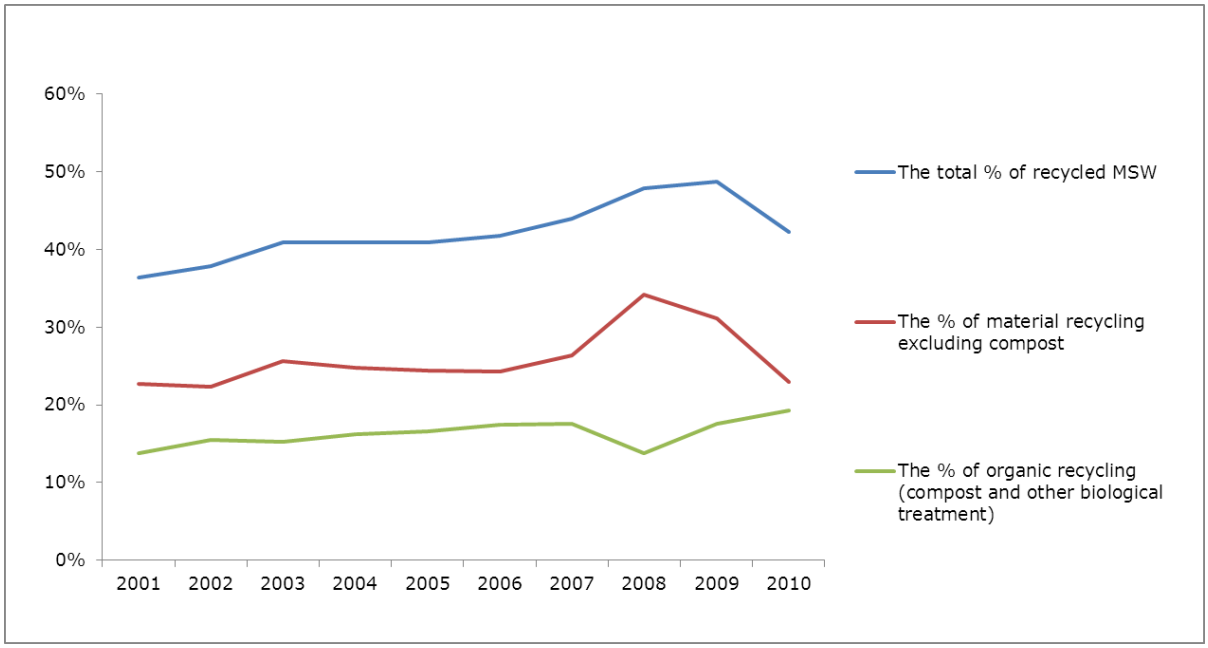
The increase of recycling from 2001 to 2008 is first of all linked to material recycling which has increased from 23 % in 2004 to 34 % in 2008 - or in absolute amounts from 799 000 tonnes to 1 559 000 tonnes. However, a decrease in material recycling is found for both 2009 and 2010, and only 23 % of the MSW consisted of material recycling in 2010.

The major increase in material recycling waste took place between 2007 and 2008, which represented an increase from 26 % to 34 %. Most of this increase (80 %) can be explained by increased generation and recycling of iron and other metal in households. In 2007, 76 000 tons of iron and other metal was reported, and 410 000 tonnes was reported in 2008, an increase of more than 500 % (Table 2.1). The Danish EPA explains that the increase is due to one undisclosed enterprise that reported this amount collected from households (Miljøstyrelsen, 2010).

Organic recycling has only increased from 14 % to 19 % in 10 years, equivalent to an increase from 483 000 tonnes to 720 000 tonnes. The main part of the organic waste recycled is garden waste from households (Table 2.1).

In conclusion, there is room for improvement of both material and organic recycling, but material recycling in particular.

Figure 2.1 Recycling of MSW in Denmark



Source: Eurostat, 2012. The percentages are calculated as % of generated MSW.

Table 2.1 Main waste fractions of household waste collected for recycling (1000 tonnes) in Denmark

	2000	2002	2004	2006	2007	2008	2009
Paper, paper packaging	181	204	221	211	246	207	221
Glass	83	111	88	85	91	65	98
Plastic	2	5	4	4	5	4	5
Metal	17	25	25	31	76	410	313
Green kitchen waste	45	37	53	41	43	38	50
Garden waste	505	512	495	592	640	527	611

Date source: SAG-database 2009 and Miljøstyrelsen 2011

2.1.2 The yearly increase rate of recycling of MSW

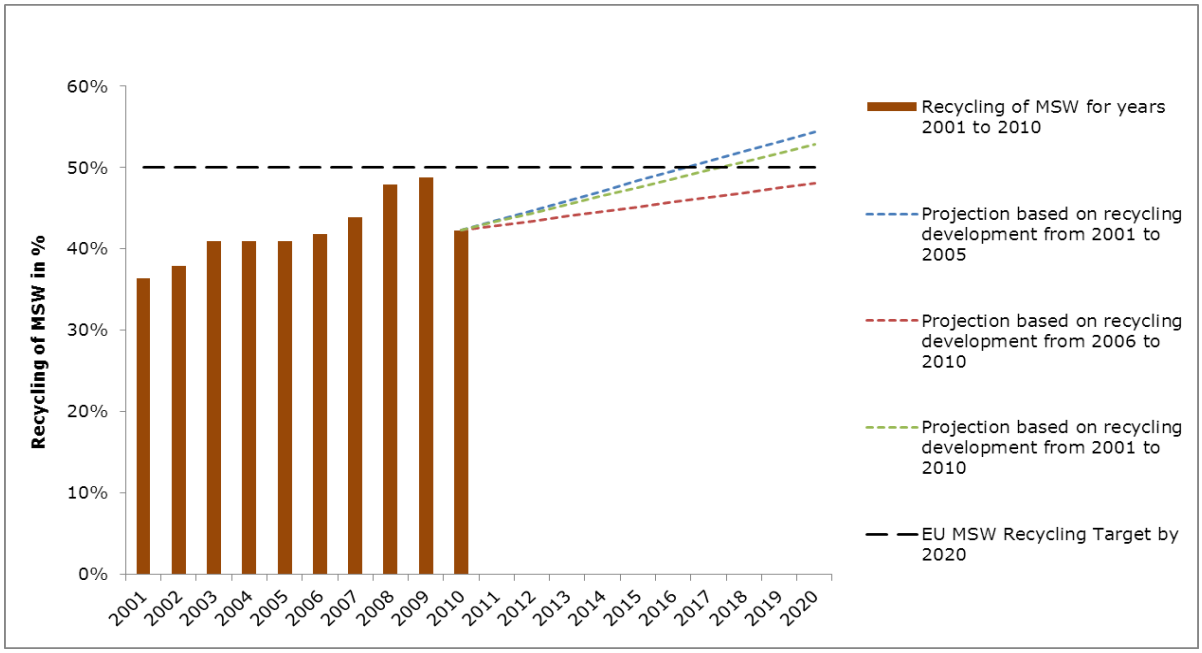
In order to assess the prospects for Denmark to meet the 50 % recycling target as set out in the Waste Framework Directive[1], three scenarios have been calculated. The scenarios assume that recycling in the period 2010 to 2020 develops, based on a linear regression, with the increase rates of recycling in the periods 2001 to 2006, 2006 to 2010 and 2001 to 2010.

Figure 2.2 shows that if the increase of recycling follows the trend from 2001 to 2010 or 2001 to 2005, Denmark would be able to fulfil the recycling target of 50 % by 2020. However, if the recycling follows the most recent trends from 2006-2010 then Denmark would not be able to fulfil the target in 2020. Since Denmark has had a very low yearly increase rate of 0.6 percentage point in the period from 2006 to 2010, it will require an increased effort to reach a 50 % recycling level by 2020.

It has to be noticed that the data for 2010 is based on 2009 data and that the scope of municipal waste has changed dramatically from 2009 to 2010. Therefore, comparison of data between 2009 and 2010 may not be fair.

[1] EU's updated Waste Framework Directive from 2008 (EU, 2008) includes a new 50 % recycling target for waste from households, to be fulfilled by 2020. In 2011, the European Commission decided that countries can choose between four different calculation methods to report compliance with this target. One of these methods is to calculate the recycling rate of MSW as reported to Eurostat (EC, 2011).

Figure 2.2 Future recycling of MSW in Denmark



Source: Calculation done by Copenhagen Resource Institute (CRI) based on Eurostat, 2012

Please note that these three scenarios are very simplistic and do not take into account any planned policy measures. In addition, they are based on one calculation methodology for recycling of municipal waste (MSW recycled/MSW generated, using data reported to Eurostat), whereas countries may choose to use another methodology to calculate compliance with the 50 % recycling target of the Waste Framework Directive. The scenarios in Figure 2.2 should therefore be interpreted only as to give some rough indications and assessment of the risk of missing the target.

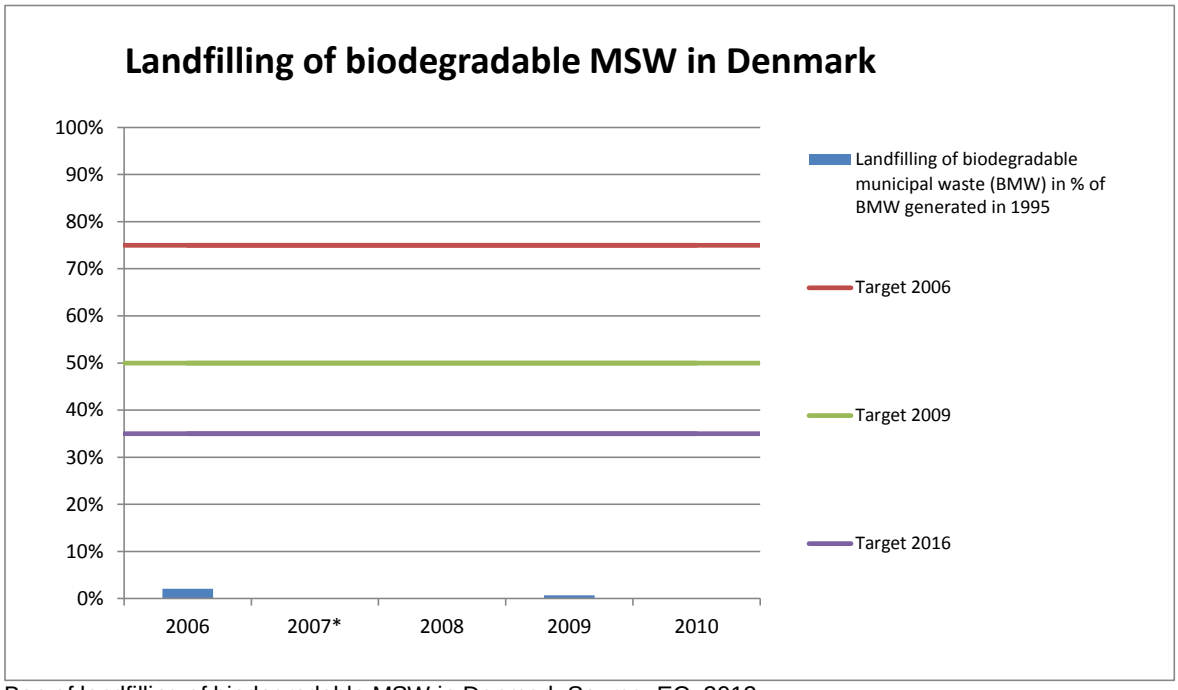
2.1.3 Landfilling of biodegradable municipal waste

According to the EU Landfill Directive, it is a general requirement that all Member States have to reduce the amount of biodegradable municipal waste landfilled (BMW) with a certain percentage by 2006, 2009 and 2016. Denmark has reported the landfilled amount of BMW to the Commission for the year 2006. The amount of BMW landfilled is far below the targets for 2006, 2009 and 2016. The amount landfilled in 2006 was 2 % of the BMW generated in 1995.

In 1997, Denmark implemented a landfill ban on biodegradable MSW.

Denmark reported to the EU Commission in 2009 that the amount of biodegradable MSW in Denmark has been for many years 1-2 % of the amount landfilled in 1995 (Miljøstyrelsen, 2009).

Figure 2.3 Landfilling of biodegradable MSW in Denmark (% of BMW generated in 1995)



Ban of landfilling of biodegradable MSW in Denmark Source: EC, 2012
* Data missing

2.1.4 Regional differences of MSW recycling from 2001 to 2010

No regional data for Denmark has been reported to Eurostat.

2.1.5 The relation between landfill tax level and recycling level of MSW

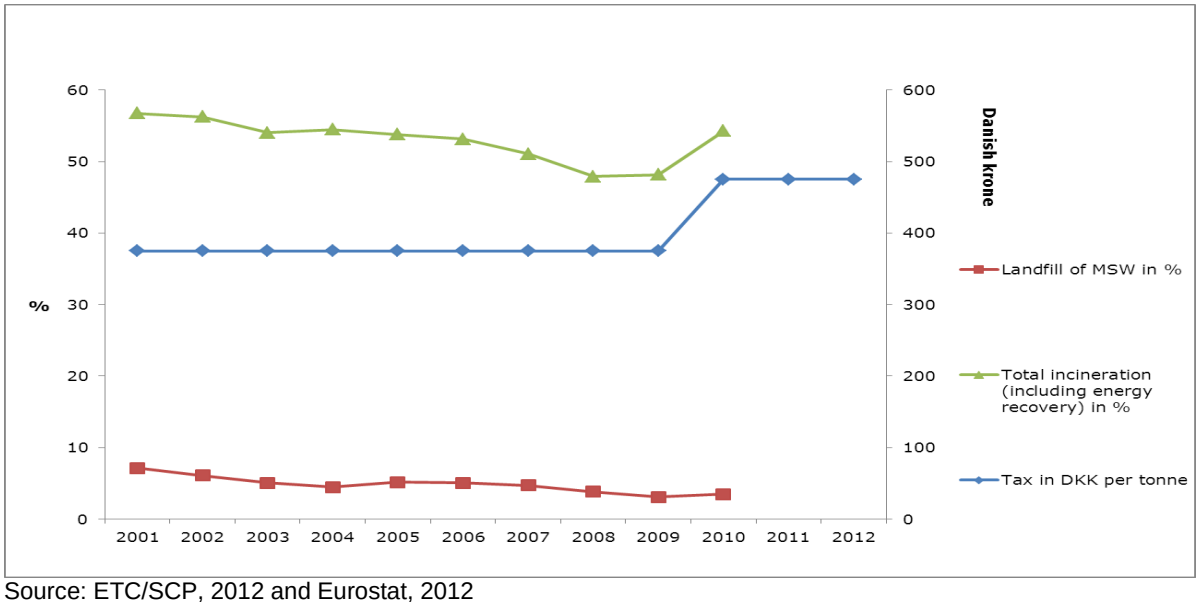
The Danish Landfill tax was introduced on 1 January 1987 along with the introduction of a tax on incineration. The aim was to create an incentive to help reduce the amount of waste going to landfills and incineration plants and so promote recycling (ETC/SCP, 2012).

Originally, the landfill tax included only landfills receiving waste from municipal collection schemes, but already by 1989 coverage was extended to all landfills with the exception of landfills for hazardous waste. In 1987, the tax was DKK 40 per ton of waste (~EUR 5.3).

The tax was increased several times during the 1990s; to DKK 160 in 1993 (~EUR 21.3), DKK 335 in 1997 (~EUR 44.7), DKK 375 (~EUR 50) in 1999 and DKK 475 (~EUR 63.3) in 2010. The tax is levied on waste delivered to registered plants and a refund is granted for waste that is subsequently removed, e.g. for recycling. In that way, the tax is only paid for the net amount received (ETC/SCP, 2012).

In the period from 1985 to 2008, the absolute amount of household waste sent to landfill declined by 0.5 million tonnes, equivalent to a reduction of 77 %. The landfill tax has played a role in this reduction, together with other measures such as a ban on the landfilling of combustible waste.

Figure 2.5 Development of landfilling and incineration of MSW and landfill tax in Denmark



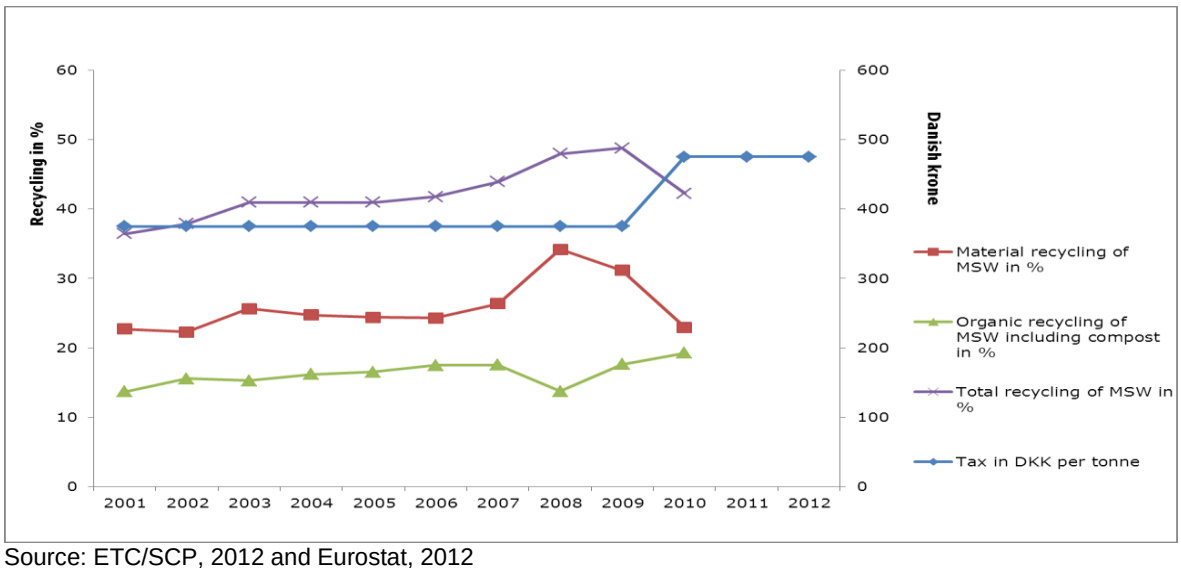
Source: ETC/SCP, 2012 and Eurostat, 2012

The landfill tax seems to have had little impact on landfilling in the last 10 years as landfilling in 2001 was already at a low level (Figure 2.5). The landfilling rate has decreased from 7.5 % to 3.5 % from 2001 to 2010.

The effect of the increase in landfill tax from 2009 and 2010 is not reflected in the data for landfilling for the same years; 3.1 % in 2009 and 3.5 % in 2010. The percentage of incineration of MSW waste has decreased from 2001 to 2009. The explanation is not linked to the landfill tax rather it might be the effect of the incineration tax in Denmark.

No correlation between recycling and the tax rate can be demonstrated for 2001 to 2010 (Figure 2.6).

Figure 2.6 Development of MSW recycling and landfill tax in Denmark



Source: ETC/SCP, 2012 and Eurostat, 2012

The tax has been stable from 2001 to 2009 while recycling has increased during the same time period.

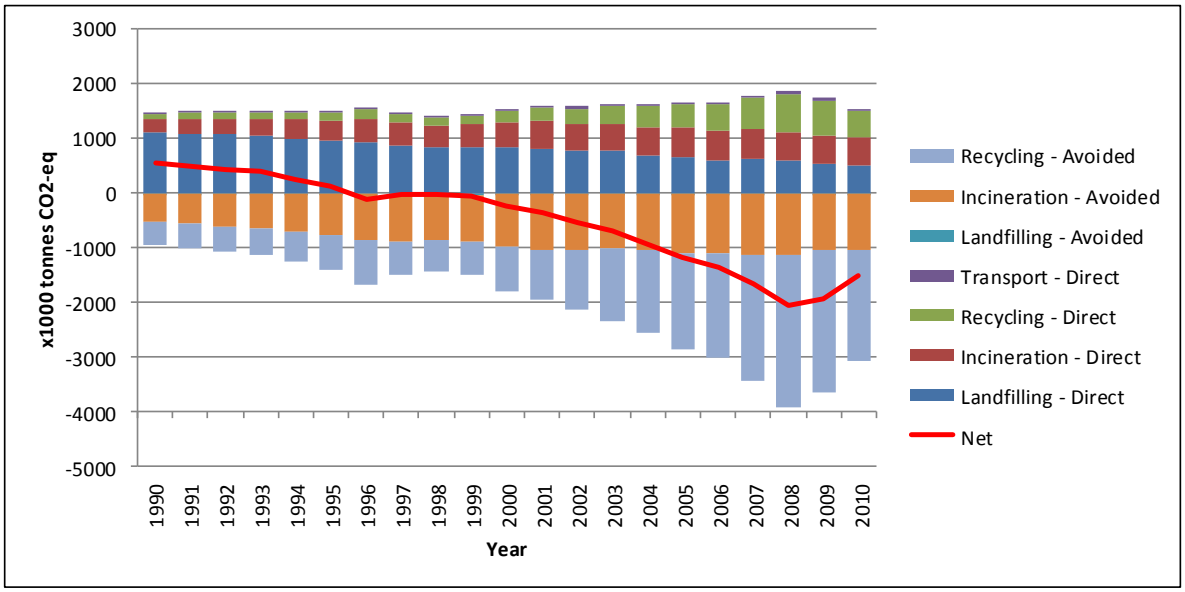
2.1.6 Environmental benefits of better MSW management

Figure 2.7 shows the development of GHG emissions from MSW management, calculated by using a life-cycle approach. The graph shows the direct emissions, the avoided emissions and the net emissions of the MSW management.

Figure 2.7 indicates a steady decrease of direct emissions from landfilling from 1990 to 2010. Since 1996, waste management in Denmark in total has had a negative net emission of GHG, that means that benefits (avoided emissions) from recycling and incineration are higher than direct emissions from landfills, incineration, recycling plants and MSW transport. If avoided emissions are higher than direct emissions, one could conclude that it would be better for the environment to generate and recycle more waste. That is of course not the case. The reason is that the model only focuses on waste management and not the full production chain and its consequences in a life-cycle perspective. Therefore, the increasing consumption of goods (and resulting generation of more municipal solid waste) is more harmful for the environment, if all life-cycle stages of materials were to be taken into account (ETC/SCP, 2011).

The reasonably large increase of net GHG emissions from 2009 to 2010 has to be seen as a consequence of reduced recycling due to the scope of municipal waste has changed dramatically from 2009 to 2010, cf. section 2.1 and 2.1.2.

Figure 2.7 GHG emissions from MSW management in Denmark



Results presented in Figure 2.7 should not be used for the compilation of GHG reporting (national inventory report of the IPCC) or compared with IPCC figures, as the methodology employed here relies on life cycle thinking and, by definition, differs from the IPCC methodology.

Assumptions concerning the production of Figure 2.7

All the GHG emissions (positive values) represent the direct operating emissions for each waste management option. These direct operating emissions have been calculated with the use of the IPCC (IPCC, 2006) methodology for landfills and life cycle modelling for the other technologies (incineration, recycling, bio-treatment and transport).

For the indirect avoided emissions (negative values), the calculations integrate the benefits associated with the recovery of energy (heat and electricity generated by incinerators, electricity generated by the combustion of landfill gas or methane from anaerobic digestion). Other avoided emissions include the benefits of recycling of food and garden waste, paper, glass, metals, plastics, textiles and wood in the municipal solid waste. Recycling is here assumed to include material recycling and bio-treatment. Avoided emissions of bio-treatment includes fertilizer substitution. All processes generating electricity are assumed to substitute electricity mix of Denmark in 2009 (IEA, 2009). Processes generating heat are assumed to substitute average heat mix for the EU-25 in 2002. The electricity mix and heat mix are assumed to remain constant throughout the whole time series. The compositions of the MSW disposed in landfills, incinerated or recycled respectively are based ETC/SCP (2011). In an Eionet consultation process, initiated by the EEA in 2012, Denmark updated the compositions of the landfilled and recycled MSW for 2009. The complete methodology is available from (ETC/SCP, 2011)

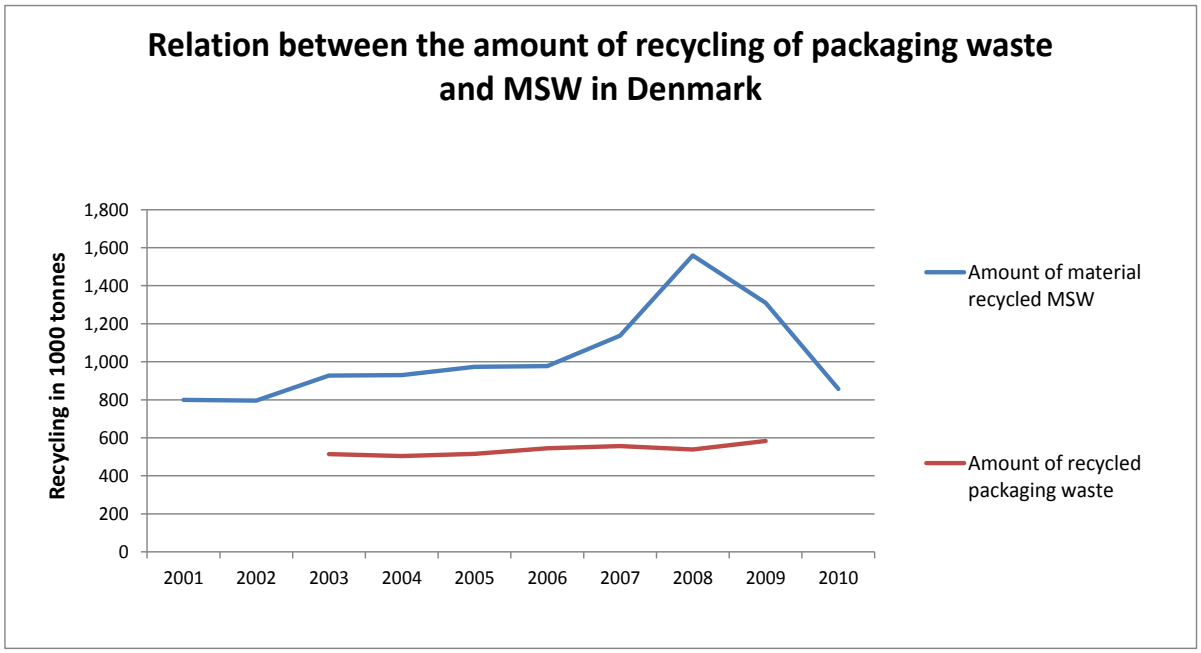
2.2 Uncertainties in the reporting

Some uncertainties or differences included in the reporting of MSW can result in different recycling levels. One example of such differences is the amount or proportion of packaging waste included.

It seems that there are some major differences regarding how much recycling of packaging waste the different Member States include in their reporting of MSW. This difference is due to the fact that most Member States have producer responsibility schemes and the packaging waste is therefore not always regarded or reported to Eurostat as MSW.

Denmark does not have producer responsibility for packaging, and data for recycling of packaging waste are included in the municipal waste. Figure 2.8 indicates that packaging waste is included in the material recycled MSW reported. Until 2009, a more detailed reporting system had been used for the recycling of packaging as the general waste statistic does not deliver data on packaging recycling in sufficient quality. One of the aims of the new data system for waste introduced in 2010 was to improve the data quality for recycling of packaging.

Figure 2.8 Comparison of packaging waste recycled and MSW recycled



Source: Eurostat, 2012.

Another uncertainty or difference in the reporting of MSW is caused by different reporting of waste treated at MBT plants. However, MBT plants are not part of the Danish waste management system and therefore not widespread in Denmark.

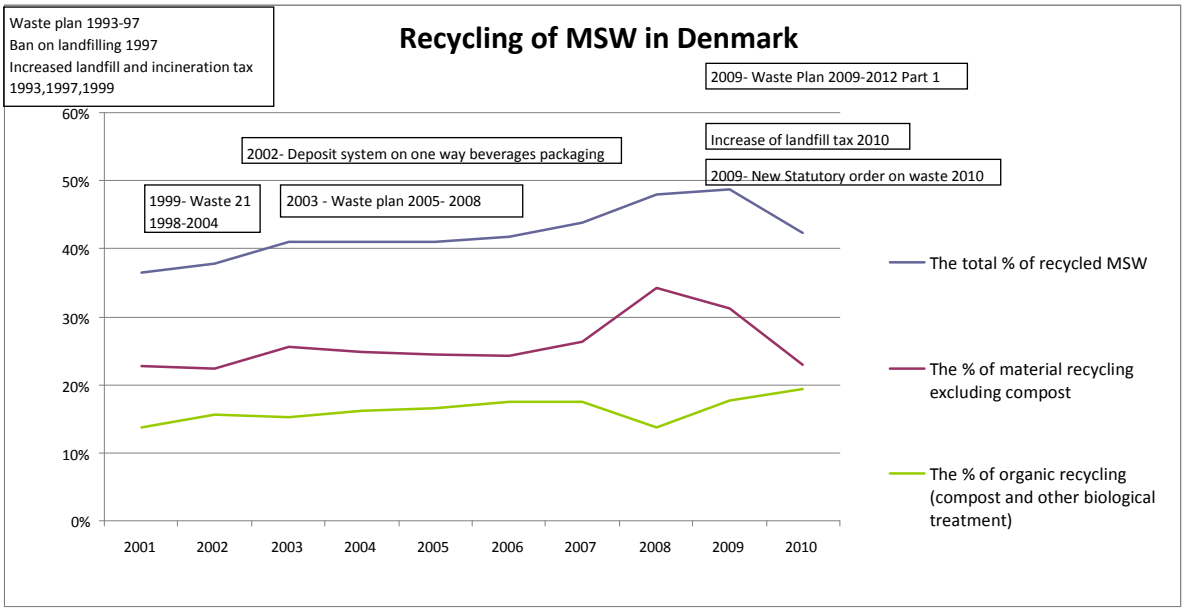
2.3 Important initiatives taken to improve MSW management

The major initiatives to improve MSW management in Denmark were taken before 2001. The landfill tax and incineration tax introduced in 1987 and the total ban on the landfilling of combustible waste (decided in 1994 and coming into effect on 1 January 1997) have been the main drivers for treatment of municipal waste in Denmark (Fischer et al., 2012). In addition, the establishment of separate collection schemes for paper, glass packaging, and garden waste has contributed significantly to the increased level of recycling.

Minor initiatives have been taken to improve MSW management from 2001 to 2010. The second national Danish Waste Plan 1998-2004 (Waste 21) set a target of 60 % recycling of paper and cardboard waste from households. Municipalities were obliged to introduce separate containers at each household for paper waste if the municipalities were performing under a certain collection rate (Regeringen, 1999). The potential in tonnes is huge. However, the data for collected paper from households have been quite stable from 2000 to 2009 (Miljøstyrelsen, 2011). During the last decade the recycling centres for household waste run by the municipalities have been expanded and more waste types can be delivered at the recycling centres.

The third national Danish Waste Plan 2005-2008 implemented the targets in the EU Directive for packaging and packaging waste to be fulfilled in 2008. A few initiatives focused on municipal waste. The municipalities had to implement collection schemes for metal packaging and certain types of plastic packaging (Regeringen, 2003). The introduction of a deposit system for one way beverages packaging in 2002 increased the amount of plastic and metal packaging waste and the amount of recycling. However, the potential in tonnes for these schemes are quite small and it is not expected to influence the total recycling of municipal waste.

Figure 2.9 Recycling of MSW in Denmark and important policy initiatives



The fourth national Danish Waste Plan 2009-2012 did not focus on new initiatives for recycling of municipal waste except a target for collection of batteries (Regeringen, 2009).

2.4 Future possible trends

Denmark is drafting a new waste management plan covering 2013-2018. The draft is planned for consultation after the summer 2012. It is expected that the plan will include initiatives to fulfil the 50 % target of recycling and prepare for reuse for household waste 2020 (Article 11 (2) in the WFD.

The indicator in Figure 2.2 demonstrated that based on the recent years' development in recycling (2006-2010), Denmark will face problems in reaching the target in 2020. It also has to be noted that the data for 2010 is based on 2009 data and that the scope of municipal waste was changed dramatically from 2009 to 2010. Therefore, the comparison of data between 2009 and 2010 may not be fair.

In addition, there is a need to have a closer look on the data for the amount of recycled metals from household waste. In 2009, the amount of recycled metals in household waste totalled up to 313 000 tonnes, yet the total amount of household waste was 3 437 000 tonnes. In other words, 9 % of the household waste consisted of metals collected for recycling. This seems to be a very high percentage compared to other European countries where 5 % was the highest amount of metal in municipal waste (UNEP, 2004).

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