

## **European household waste management schemes: their effectiveness and applicability in England**

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## **Abstract**

This paper reviews European household waste management schemes and provides an insight into their effectiveness in reducing or diverting household waste. The paper also considers the feasibility of replicating such schemes in England. Selected case studies include those implemented using variable charging schemes, direct regulation and household incentivisation (reduced disposal charges). A total of 15 case studies were selected from developed countries in the EU where some schemes have operated for more than a decade. Criteria for assessing the effectiveness and replicability of schemes were developed using scheme progress towards targets, response time, compatibility with government policy, ease of administration and operation, and public acceptance as attributes. The study demonstrates the capability of these schemes to significantly reduce household waste and suggests changes to allow their possible adoption in England. One of the main barriers to their adoption is the Environmental Protection Act, 1990 that prevents English local authorities (LAs) from implementing the variable charging method for household waste management. This barrier could be removed through a change in legislation. The need to derive consistent data and standardise the method of measuring the effectiveness of schemes is also highlighted.

*Keywords:* Household waste; waste reduction; waste diversion; economic instruments; regulatory instruments; incentivisation

## **1. Introduction**

Waste is generated by activities in all economic sectors and often indicates the inefficient use of natural resources (Phillips et al., 2001), loss of materials and energy

in production processes and unsustainable consumption patterns (EEA, 2002). Currently in England 67% of municipal solid waste (MSW) generated is landfilled, 9% incinerated and 23.5% recycled or composted (DEFRA, 2006). Results of the latest survey show that in England 29.7 million tonnes of MSW was produced during 2004/05, which was 2.1% more than that produced in 2003/04. However, the average annual MSW increase in England is 1.5% from 2000/01 to 2004/05. Out of this, 25.7 million tonnes (about 86%) was from households alone (DEFRA, 2006). It has been reported that the amount of total household waste and per capita waste increased by around 15% and 12%, respectively, between 1996-97 and 2002-03 (EEA, 2005). However, no further increase in the household waste production was observed until 2004-05 (DEFRA, 2006). Household waste is mainly comprised of paper and card, kitchen and garden waste. The Waste Strategy 2000 set MSW recycling or composting targets at 33% by 2015 (DETR, 2000). Also, in the UK, the EU Landfill Directive (1999/31/EC) requires the reduction in biodegradable municipal waste to 75% of the 1995 disposal level by year 2010 and 35% reduction by 2020. Therefore, England requires more sustainable and practicable waste management methods to comply with the EU Landfill Directive. A universal waste hierarchy is suggested for developing a sustainable waste management strategy, the elements of which include prevention, reuse, recycle, recover and finally disposal in landfills (Fiorucci et al., 2003).

Continuous rise in waste quantities is imposing economic and environmental costs on society in most of the European countries for its management (EEA, 2000). The increase in the amount of waste is mainly attributed to the inability of member states to decouple economic growth from waste growth. According to European

Environment Agency report (EEA, 2002), only Germany, the Netherlands, Iceland, and to a lesser extent Sweden and Denmark, have been successful in decoupling economic growth and growth in waste production. This decoupling is an objective of the 6<sup>th</sup> Environment Action Programme (2001-2010) (Gervais, 2002).

In Europe, the implementation of the waste hierarchy has become difficult due to complexity and multidisciplinary problems involving social, economic, environmental and technical aspects (Philips, *et al.* 2001). However, laws have been established by governments at international, national, regional and local levels to facilitate the establishment of challenging targets and to ensure a more sustainable approach to waste management in which less waste is produced and more waste is either reused or value recovered from it. As a result, the use of household waste management schemes has become widely acceptable for effective waste management towards the top of the waste management hierarchy, i.e. waste reduction.

Several schemes based on economic, regulatory and incentive instruments have been successfully used in Europe to manage municipal waste (INFORM, 2005; Eunomia, 2002, 2003; Green Alliance, 2002; Dungan, 2003). Economic instruments refer to schemes established based on variable charging in order to implement the polluter pays principle. In these schemes, the local authorities (LAs) charge fees from householders for managing their waste. Regulatory instruments refer to the laws or regulations that are introduced by governments in order to enable the LAs to use them in the establishment of schemes. Incentive based instruments refer to schemes in which LAs provide some financial assistance or other ways to encourage householders to participate in waste management. The performance of the schemes in

different countries varies depending on the social, economic, political and physical conditions of the areas.

In the present study, the focus is on the reduction of household waste in England using economic, regulatory and incentive based instruments that have already been used in Europe to implement strategies by LAs in order to address the waste issue. So this paper reviews household waste management schemes implemented in Europe, assesses their effectiveness in achieving the set targets and considers their replicability in England.

## **2. Materials and methods**

### ***2.1 Procedure and selection of selected schemes***

To review household waste reduction schemes, a method for selecting the schemes was required. Schemes were selected after extensive literature review and consultation with the Environment Agency (EA). However, most of the studies were taken from two Eunomia reports (Eunomia 2002, 2003). The most relevant schemes from Europe were chosen as they share a number of common features. For example, EU Member States have to comply with common legislation on waste management such as the packaging directive. It was expected that Member States would provide a wide range of credible data for good analysis and comparison. It was ensured that selected schemes cut across the principal instruments (economic, regulatory and incentivised) used for the implementation of waste management schemes.

After a comprehensive literature review, the following fifteen household waste management schemes were selected for our study:

1. Belgium: Pay-Per-Bag scheme (Eunomia, 2002, 2003)
2. Denmark: Weight-based charging scheme (Eunomia, 2002, 2003)
3. Germany: Weight-and volume-based system (Eunomia, 2002)
4. Italy: Tagged bag scheme (Eunomia, 2003)
5. Luxemburg: Combined volume and weight-based scheme (Eunomia, 2002, 2003)
6. Sweden: Weight-based scheme (Eunomia, 2002)
7. Ireland: Plastic bag environmental levy (Dungan, 2003)
8. Germany: MSW management scheme (INFORM, 2005)
9. Belgium: BEBAT scheme for battery collection (Eunomia, 2003)
10. Finland: Paper collection scheme (Eunomia, 2002)
11. Belgium: Brussels scheme for the management of waste paper and board (Eunomia, 2002)
12. Netherlands: Paper and fibre collection (Eunomia, 2002)
13. Belgium: Flanders MSW management (Green Alliance, 2002; Eunomia, 2002)
14. Sweden: Home composting scheme (Eunomia, 2002)
15. United Kingdom: West Sussex 'Real Nappy' initiative (Eunomia, 2003).

## ***2.2. Review of schemes***

A preliminary review was performed during an extensive literature survey for all selected 15 schemes. During the survey, the important issues in the schemes were identified and critically examined. These include the methodology of establishing the scheme (i.e., data gathering on waste arising, quantities, number of households to be served etc.), the operational and administrative requirements of the scheme, the targets set to be achieved, the level of target actually achieved and the time period within which the achievement of the set target was desired. The limitations of each

scheme were highlighted, and the effectiveness and replicability of each scheme were considered on the basis of observations.

For a more detailed review of the 15 schemes, the data was normalised in order to compare and assess the effectiveness of the schemes.

### ***2.3 Assessment of the effectiveness of schemes***

The effectiveness of schemes is an essential aspect of this study. To appropriately comment on the effectiveness of the schemes, criteria were developed using achievement, time and costs as basic parameters.

Achievement of each scheme was judged based on the total quantity of waste reduced or diverted. Figures provided were normalised to waste kg/cap/yr for better understanding and ease of analysis and comparison. Waste reduction or diversion was scored based on performance as presented in Table 1. The quantities of waste for diversion are higher than those of reduction because household waste diversion, which is largely achieved through recycling and composting, is more easily achieved than reduction at source. Skumatz (2000) observed that source reduction schemes have attracted less attention than recycling because source reduction is difficult to achieve, difficult to quantify, can be tedious and can be data intensive.

Time refers to the period expected to achieve the set targets by the scheme. This is considered as an important parameter for assessing the effectiveness of schemes because programmes are time bound, otherwise they could be unnecessarily expensive to achieve the goals. Therefore, weighted scores were also allotted to time taken to

reduce or divert a certain quantity of waste, which is shown in Table 2. For the 15 case studies, the score points also differ in respect of reduction and diversion due to similar reasons as for the case of achievement.

The cost of schemes (capital and operational) is the third parameter considered for assessing the effectiveness of a scheme. Although this parameter is important in assessing effectiveness, it was not possible to develop a criterion for costing the schemes due to the following reasons: (a) great variations amongst countries in the ways household wastes management schemes are designed and managed. For instance, costs for kerbside waste collection will greatly differ from drop off or take back methods for recycling schemes, (b) the administrative and operational costs for running schemes could be hugely different from one country to another due to the technical requirements for operating the schemes, for example, the lock gate scheme in Germany, which was described as technically cumbersome and (c) lack of data on cost of schemes; of the fifteen schemes only the German lock gate scheme provided any cost data, in the form of total equipment cost without regard to operational and administrative costs.

Due to the constraints above, the assessment of selected schemes on a cost basis was not viable. This is a limitation of the assessment. The assessment of the effectiveness of the scheme was therefore limited to two parameters, that is, achievement in terms of the quantity of waste reduced or diverted and the time it takes to achieve set targets. The criteria for ranking the schemes are shown in Table 3.

#### ***2.4 Applicability of schemes to England***



To determine the replicability of the schemes reviewed in England, a criterion was developed using effectiveness of schemes, ease of operation, compatibility with government policies and public acceptability as key parameters. Each parameter was scored with a maximum of 5 points. The following three categories of replicability were proposed: (a) readily replicable (R) schemes, that are in harmony with the above parameters, which do not require any modifications to be implemented (16-20), (b) modified (M) schemes, that will require some modification to enable them to be replicated, due to non conformity with some of the parameters (11-15) and (c) difficult (D) scheme, which refers to schemes that will be extremely difficult to be adopted with respect to the scheme's non-conformity with government policy and effectiveness parameters (5-10).

### **3. Results**

#### ***3.1 Detailed review***

A summary of the selected 15 schemes reviewed is presented in Table 4. It essentially indicates that three instruments (economic, regulatory and incentive based) are widely used in establishing household waste management schemes. Out of the 15 schemes, 7 schemes were established using economic instruments, 6 using regulatory instruments and 2 schemes were established based on householder incentivisation.

##### ***3.1.1. Performance of schemes based on amount of waste reduced or diverted***

Assessing the performance of the schemes with regards to the amount of waste reduction or diversion is one of the key objectives of this study. However, only 4 out of the 15 schemes could be compared based on performance because the 4 schemes provided data on clear targets and achievements in similar units or in units that were

agreeable after conversion. In the remaining schemes data were either provided for achievements or targets only, and in some instances, in percentages without actual values to allow conversions. The results presented in Fig. 1 indicate that waste reduction/diversion rate of up to 95 kg/cap/yr was achieved in the case of a paper recovery scheme in Finland. The results also indicate that set targets were actually exceeded by two schemes, the Belgian MSW diversion scheme (target 35 kg/cap/yr; achieved 40 kg/cap/yr) and the Irish plastic bag scheme (target 2 kg/cap/yr; achieved 4 kg/cap/yr). In the remaining schemes although targets were not fully achieved, performances ranged from 53 to 67%. The actual quantity of waste reduced or diverted / kg/cap/yr is shown in Table 5. The results also showed that the quantities of wastes reduced or diverted by the schemes range from 4 kg/cap/yr in the Irish plastic bag scheme to 1600 kg/family/yr in the West Sussex real nappy scheme. The amount seems small after normalisation by comparing the quantity achieved by the scheme with various per capita waste generation of the country where the schemes are implemented. Thus performances after normalisation range between 0.01 to 5 kg/cap/yr.

It is observed that the performances differ greatly between schemes due to the different waste streams handled by schemes and whether the goal of the scheme was waste reduction or diversion.

### ***3.1.2. Performance of economic instruments based schemes***

The performance of 6 out of the 7 schemes based on economic instruments was compared. The results obtained are presented in Table 5. The Danish weight-based MSW scheme achieved a diversion rate of up to 120 kg/cap/yr (0.2 kg/cap/yr,

normalised) whilst the Irish plastic bag levy scheme achieved a 4 kg/cap/yr (0.01 kg/cap/yr, normalised) reduction rate. On average, the economic instrument based schemes achieved reduction/diversion rates of 43 kg/cap/yr of the targets they were set to achieve. However, the average achieved in terms of actual waste reduction was not normalised because of the differences in the per capita waste production of the countries.

### ***3.1.3. Performance of regulatory instruments based schemes***

Achievement results of the schemes established using regulatory instruments indicate that the amount of waste reduced or diverted by the schemes are 40 and 95 kg/cap/yr for Belgium (MSW Flanders scheme) and Finland, respectively. Table 5 shows the achievement of these two schemes that provided data on their targets.

### ***3.1.4. Performance of incentivised schemes***

Two schemes in the 15 case studies were based on provision of incentives to householders in order to encourage them to participate in waste management schemes. The schemes include the Swedish household composting and the West Sussex real nappy scheme in the UK.

The Swedish households using the scheme, composted an estimated quantity of 1600 tonnes/yr of food wastes, this reduced the amount of waste going to landfill by about 6 kg/cap/yr (0.01 kg/cap/yr, normalised) in communities where the scheme was used (Table 5). Households that have installed composting facilities within their area were qualified to apply for a reduction in waste fees. In the year 2000, the total fee reduction (incentive) to households corresponds to €211,111/yr (~ £131,944) or

€133.3/household/yr (~ £83.30). The West Sussex real nappy scheme provides free laundry services for families using the scheme. The results of the scheme show that 500 families participated in the scheme between 1999 and 2000 and this saved the production of 800 tonnes of disposable nappies as well as cost savings of €32,000 (~ £20,000) for the local authority. The waste reduction per family that used the scheme translated to 1600 kg /family/yr and the incentive provided amounted to €48/family/yr (~ £30).

### ***3.2. Assessment of the effectiveness of schemes***

Assessment of the effectiveness of schemes was the major objective of the present study. Three parameters considered for developing the criterion for assessing the effectiveness of the schemes were achievement, time and total costs of schemes as explained in section 2.3. The schemes were categorised in to three groups based on the instruments used for establishing them to allow for comparison of the effectiveness between the schemes and to explain the differences observed in the discussion section. The assessment was categorised as good, fair or poor based on their scores. The results of the effectiveness are presented in the following sections.

#### ***3.2.1. Effectiveness of economic instrument schemes***

The results of the assessment of the effectiveness of the economic instrument based schemes is presented in Table 6. Within the confines of the assessment criterion used, the results indicate that two of the schemes (Ireland and Denmark) were ranked as good, and the remaining four were rated as fair (Belgium, Luxemburg, Italy and Sweden). The remaining scheme from Germany in this category was not rated due to a lack of data.

### ***3.2.2. Effectiveness of regulatory instrument schemes***

The results of the assessment of the effectiveness of the schemes established based on regulatory instruments are presented in Table 7. Within the limits of the criterion used, the results indicate that the paper recovery scheme from Finland was the most effective and ranked as good. Three other schemes were rated as fairly effective whilst two schemes were not rated due to insufficient information.

### ***3.2.3 Effectiveness of incentivised schemes***

The results of the assessment of the effectiveness of the incentivised schemes are presented in Table 8. The results indicate that the Swedish household composting scheme was rated as fairly effective based on the criterion used whilst the real nappy scheme was rated as good.

### ***3.3. Assessment of the applicability of schemes in England***

The potential replicability of the reviewed schemes in England was a key objective of our study. As a result, a criterion for determining the replicability was developed using compatibility with government policies (particularly on variable charging) as a major parameter, with effectiveness of scheme, public acceptability and ease of operation and administration being complementary parameters, as discussed in section 2.4. The results presented in Table 9 show that only four of the 15 schemes could be readily replicated in England, out of which three schemes are regulatory and one is incentive based. Further analysis shows that 6 out of the 15 schemes would require modifications in order to be replicated in England (2 schemes are economic, 3 are regulatory based and 1 is incentive based). The results also indicate that 5 (all are

economic instrument based) out of the 15 schemes would be difficult to replicate in England.

## **4. Discussion**

### ***4.1. Performance of economic instrument schemes***

Economic instruments are essentially based on the polluter pays principle, which puts the responsibility of waste management on the producer of waste, in this case, the householders. The instrument is known by different names in different countries such as the variable charging, unit-based pricing, pay-as-you-throw, etc. The variable charging system could be based on weight, volume or weight and volume.

As could be seen in this review, 7 of the 15 reviewed schemes were established using economic instruments based on variable charging. The use of economic instruments to establish waste management schemes in Europe is well accepted and it is used in Belgium, Italy, France, Germany, Sweden, Spain, etc. The results in Table 5 show that the Danish MSW and Irish plastic bag schemes both established under the variable charging system have made significant MSW reduction and diversion respectively. The Danish scheme diverted 120 kg/cap/yr of MSW, which translates to 0.2 kg/cap/yr of the actual reduction when compared with the Danish per capita waste production of 530 kg/cap/yr, and the Irish scheme reduced 4 kg/cap/yr of plastic bag waste, which translates to 0.01 kg/cap/yr, when compared with the Irish per capita MSW production. In the 6 schemes, which provided data, the use of economic instruments made a significant reduction or diversion of MSW. The reason for the increasing popularity of variable charging is the economic incentive of having to pay for waste management by the amount generated which rewards recyclers and which

has caused a subsequent reduction in tonnes of waste in communities where the instrument is used. This is in consensus with the views of Shapiro (1995) that the variable charging system provides a direct economic incentive for people to prevent waste generation, to recycle and to compost.

A survey of LAs to assess attitudes towards direct charging of householders for waste management services suggests that existing legislation does not permit LAs to use variable charging schemes (Eunomia, 2003). The report identified direct charging barriers and mechanisms for increasing recycling through household participation. The public may not welcome the variable charging method because of the general belief that waste collection is already paid for through the council tax (Price, 2001; Rayner, 2003). Government has ruled out charging schemes for the foreseeable future despite considerable analysis (Ernst & Young, 2002) but such schemes have not been ruled out altogether. The Government has however ruled out a separate national tax on household waste (HM Treasury, 2003) which is an alternative option. The Local Government Association (2004) is lobbying Government to give power to councils to implement direct and variable charging schemes. Despite existing legislation, LAs are able to charge for excess waste by restricting the size of containers they provide. In this manner, home composting can also be encouraged and waste production can be significantly reduced. The House of Commons Environment Food and Rural Affairs Committee (2003, 2005) is strongly in favour of LAs being given the ability to introduce variable charging schemes if they so wish but argues that they should only be introduced if they do not have an unfair impact, especially on low income families. Potentially, direct charging could reward those households that produce less waste.

However, in England, kerbside collection is increasing under the provisions of the Household Waste Recycling Act 2003 that aims to increase the amount of recyclables to meet the prescribed targets (DEFRA, 2005). English waste collection authorities are to collect separately at least two types of recyclables at the kerbside from all households by 2015 at reasonable cost. Under the act, materials recycling facilities (MRFs) are not an acceptable alternative for the separate collection of two different types of recyclables. In order to comply with the act, direct charging can be implemented for excess waste. Some EU member states are already performing significantly better than England, for example Austria collected >65% and the Netherlands and Germany both around 40% of all MSW as separate waste fractions in 1999 (European Commission, 2003). Householder charging is much the most widely used instrument to influence waste generation and reductions in residual waste (Resource Recovery Forum, 2004).

#### ***4.2. Performance of regulatory instrument schemes***

Regulatory policy is an instrument based on legislation introduced by countries in order to address waste problems. In most cases, some form of legislation is required to force the implementation of a waste management scheme. The result of this study shows (in Table 4) that 6 of the schemes reviewed were established using regulatory instruments. It is evident from the study that regulatory instruments can successfully be used to address the generic MSW problem. However, most of the regulatory instrument schemes were assessed for specific waste streams.



Within the limitations of the criterion used for assessing the effectiveness of the schemes, there seems to be no significant difference in achievements between the regulatory based schemes.

All six regulatory-based schemes were established through producer responsibility with respect to household wastes. For instance, the 1993 Belgian law of ecotaxes aimed to give incentives to consumers to change their behaviour towards product consumption in an environmentally friendly way. In order to achieve this, a tax was imposed on a range of products to be sold. Therefore, the BEBAT scheme was introduced to collect used dry batteries for subsequent recycling. The batteries are exempt from ecotax if the manufacturers agree to set up a recycling and collection scheme. The paper schemes of Finland and the Netherlands targeted waste paper collection from households. In the Netherlands scheme, local authorities are responsible for collecting paper and board from the household. The paper industry then purchases this material from LAs and it pays for further processing and disposal. All the schemes were implemented through producer responsibility. The main reason for the participation of industries in household waste schemes may be attributed to the imposition of tax on certain products. An increased price due to tax might bring a change in public perception towards the use of products. This may eventually reduce the market of such products.

Good performance of most regulatory schemes is observed as it is easier to identify, separate and collect the specific waste streams. Also, breach of legislation may result in prosecution to the waste collectors and producers (Green Alliance, 2002).

### ***4.3. Incentivised schemes***

Incentivised instruments are essentially based on the provision of incentives in cash or kind by waste management authorities to householders who participate in schemes. Two of the reviewed case studies were established based on the provision of incentives to householders who wish to participate in waste management schemes implemented by LAs. The results of the use of incentives to address household waste show a dramatic performance by the West Sussex real nappy scheme, which reduced at source 1600 kg/family/yr (Eunomia, 2003). The use of incentive schemes also achieved some diversion of *ca.* 6 kg/cap/yr of household waste to landfill in Sweden, which translates to 0.01kg/cap/yr, when compared to the Swedish 530 kg per capita waste generation. The performance of the two schemes was surprising because incentivised schemes do not seem to perform so well in reality. This is because the choice to participate in the scheme is entirely the decision of the householders, who despite the incentives on offer, may not feel comfortable to participate in recycling or composting of their waste. This is supported by Rayner (2003), who demonstrated in a newspaper survey report that some UK residents “avoided the recycling route by continuing to put everything in one bin for the general rubbish”, their argument being that they have paid for waste management and could not understand why they should be involved.

The reason for the good performance of the two incentive-based schemes in West Sussex could be because they targeted specific waste streams and the wide publicity enjoyed by the scheme. This is supported by the fact that most of the schemes that addressed specific waste streams have significantly reduced or diverted waste, for

example as seen in the case of plastic bags in Ireland, battery collection and recycling in Belgium and paper recovery in Finland.

#### ***4.4. Effectiveness of schemes***

The criteria used for assessing the effectiveness of the schemes have already been presented in detail in section 2.3.

##### ***4.4.1. Effectiveness of the economic instruments based schemes***

The results of the assessment of the effectiveness of schemes based on economic instruments are presented in Table 6. The reason for the good performance of the Irish and Danish schemes is that both targeted specific waste streams (plastic bags and household composting) which make it easier for the householders and the operators to manage than total MSW that might require sorting before treatment or disposal. An additional reason for the effectiveness of the Irish plastic bag scheme is probably the charge of €6.7/kg (~ £4.20) which is higher than all other charging schemes reviewed. This cost might have been responsible for the change of people's behaviour, which is a greater challenge to waste reduction (Grigg and Read, 2001).

##### ***4.4.2. Effectiveness of the regulatory instruments***

The results of the effectiveness of the regulatory instrument based schemes are presented in Table 7. Using our criteria, only the Finland paper recovery scheme was rated as effectively good. The reason for this is probably twofold; firstly there is a long demand-lead history of paper recycling in Finland dating back to the 1940s; and secondly due to the involvement of the most experienced paper company in Finland (Paperinkerays Ltd), in the scheme, whose responsibility is to collect and recover

waste paper from households and offices. Paperinkerays maintains an information system pertaining to waste paper operations. The success of the scheme is also attributable to involvement of property owners in waste paper collection. Property owners were responsible for the provision of containers and collection of waste paper. Three of the schemes were rated as fairly effective and the other two could not be assessed due to lack of data. The effectiveness of the schemes could be attributable to being waste stream specific e.g. the battery and waste paper and board schemes in Belgium and the paper recovery schemes in Finland and the Netherlands, possibly due to ease of identification and handling. Another reason is that under producer responsibility, there don't seem to be financial constraints for the operation of schemes and possible monitoring by government to ensure compliance. In the producer responsibility schemes reported in the literature, there are proper arrangements for financing the schemes by the stakeholders and all of them become obliged.

#### ***4.4.3. Effectiveness of incentivised schemes***

The Swedish household food composting scheme was rated as fairly effective whilst the West Sussex real nappy scheme was rated as good. The reason for the effectiveness of the West Sussex real nappy scheme is the intensive campaigning and the assistance by hospitals, health officers, the local media, and increasing support from householders. Another possible reason for effectiveness could be the need to protect babies from rashes due to poor ventilation caused by the plastic content of non-real nappies.

#### ***4.5. Applicability of schemes in England***

The result of the assessment of the potential replicability of schemes in England shows that only 6 of the reviewed schemes could be directly replicated in England (Table 9). This is because the schemes were implemented using the producer responsibility that is already well established in the UK through the Environment Act 1995. The two other schemes that could be readily replicated were established based on the provision of incentives, which is a widely accepted method of implementing schemes in the UK. The real nappy scheme is a good example of an incentive-based scheme in the UK.

The results further suggest that 10 of the 15 schemes could be replicated in England with some modification. Most of these schemes were based on the variable charging system, which is not currently permitted in England. Some schemes, although not based on variable charging, would need modification because they employ fines of up to \$10,000 per day (~ £5,600) on any county that fails to comply with the recycling targets (Green Alliance, 2002). These measures are not popular in Europe and would not be readily accepted in England.

### **5. Conclusions**

Household waste management schemes adopt economic, regulatory or incentive based instruments that are widely acceptable across Europe. Many such schemes have been successful in achieving waste reduction. In the absence of a standardised method of measuring effectiveness of schemes, the quality of assessing the effectiveness of schemes is within the constraints of our criterion developed. This emphasises the need

for consistent data and in particular the need to standardise the measurement of effectiveness. Furthermore, whilst the success of some individual schemes can be highlighted, there is a lack of transparent data on the costs of commissioning, operating and monitoring household waste management schemes in relation to their waste reduction or diversion achievements. Schemes that are designed to manage specific waste streams achieve the greatest reduction or diversion, rather than the general MSW stream.

Although some schemes were found to be highly effective, many cannot be replicated in England due to the policy barrier created by the Environmental Protection Act 1990 which prohibits variable charging by LAs to implement waste management schemes. This suggests the need for central government to review policy with respect to that Act.

The waste paper and board, real nappy and BEBAT schemes provide good potential for achieving waste reduction at household levels. In addition to these, the Belgian and German MSW schemes, Irish plastic bag environmental levy scheme, Netherlands waste paper scheme and Swedish home composting schemes would require modifications before possible implementation.

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## Reference

- Council of European Committees. Directive 1999/31/EC of the European Parliament and of the Council of 27 September 2001 of 26 April 1999 on the landfill of waste. *Official Journal of the European Communities 1999*, L 182, 16/07/1999.
- DEFRA, 2005. Department of the Environment Food and Rural Affairs (DEFRA). Municipal waste management statistics 2003/04. London, UK.
- DEFRA, 2006. Department of the Environment Food and Rural Affairs (DEFRA). Statistical Release. London, UK.
- DETR, 2000. Department of the Environment, Transport and the Regions (DETR). Waste strategy 2000 for England and Wales. London, UK.
- Dungan, L., 2003. What were the effects of the plastic bag environmental levy on the litter problem in Ireland?  
<http://www.colby.edu/personal/t/thieten/litter.htm>
- Ernst & Young, 2002. Analysis of the application of the producer pays principle to producers of household waste as a driver towards sustainability: a preliminary discussion document. London, UK.
- Eunomia, 2002. Financing and incentive schemes for municipal waste management case studies. Final Report to Directorate General Environment, European Commission.
- Eunomia, 2003. Eurocharge: charging schemes for waste management and the barriers to their introduction in the UK. Final report to IWM (EB), Northampton, UK.

- European Commission, 2003. Waste generated and treated in Europe: data 1990-2001. Luxembourg: Office for Official Publications of the European Communities. ISBN 92-894-6355-4
- European Environment Agency (EEA), 2000. Household and municipal waste: comparability of data in EEA member countries. Copenhagen, Denmark. Topic Report No.3/2000.
- European Environment Agency (EEA), 2002. Case studies on waste minimisation practices in Europe. Copenhagen, Denmark, Topic Report No. 2/2002.
- European Environment Agency (EEA), 2005. The European Environment - State and Outlook 2005. Copenhagen, Denmark. Environment Report No. 1/2005.
- Fiorucci, P., Minciadi, R., Robba, M. and Roberto, S., 2003. Solid waste management in urban areas development and application of a decision support system. Resour. Conserv. Recy., 37: 302-303.
- Gervais, C., 2002. An overview of European waste and resource management policy. Royal Society for Natural Conservation and Forum for the Future, London.
- Green Alliance, 2002. Creative policy packages for waste: lessons for the UK. <http://www.greenalliance.org.uk/>
- Grigg, S.V.L. and Read, A.D., 2001. A discussion on the various methods of application for landfill tax credit funding for environmental and community projects. Resour. Conserv. Recy., 32: 389-409.
- HM Treasury, 2003. Budget 2003: Building a Britain of economic strength and social justice. Chapter 7: Protecting the environment.
- House of Commons Environment Food and Rural Affairs Committee, 2003. Eighth Report of Session 2002-03 The Future of Waste Management, Volume I - Report, together with Proceedings of the Committee. HC 385-I. London, UK.



- House of Commons - Environment Food and Rural Affairs Committee, 2005. Fourth Report of Session 2004-2005 - Waste policy and the Landfill Directive. HC 102. London, UK.
- INFORM, 2005. Executive summaries. INFORM: Strategies for a better environment. <http://www.informinc.org/>
- Local Government Association, 2004. 10 easy ways to prevent waste. London. <http://217.154.109.138/Documents/Publication/waste%20guide%20WEB.pdf>.
- Phillips, P.S., Pratt, R. M. and Pike, K., 2001. An analysis of UK waste minimisation clubs: key requirements for future cost effective developments. *Waste Manage.*, 21: 389-404.
- Price, J.L., 2001. The landfill directive and challenge ahead: demands and pressures on the UK householders. *Resour. Conserv. Recy.*, 32: 333-348.
- Rayner, J., 2003. Media highlights diverse views. *Material Recycling Week*, 181: 3.
- Resource Recovery Forum, 2004. High diversion of municipal waste: is it achievable? Report prepared by David Davies Associates, Shropshire, UK. <http://www.resourcesnotwaste.org/>
- Shapiro, M., 1995. Unit pricing: a viable option for MSW managers. *MSW Management*, March/April: 60, 68, 70.
- Skumatz, L.A., 2000. Measuring source reduction: Pay as you throw/variable charging rates as example. Skumatz Economic Research Associates, Inc, Seattle, WA..

**Table 1**

**Assessment for achievement of the schemes based on the total quantity of waste reduced or diverted**

Criteria	Scale kg/cap/yr	Points
Reduction	< 3.9	2
	4 - 7.9	4
	8 - 11.9	6
	> 12	8
Diversion	< 19	2
	20 - 39	4
	40 - 79	6
	> 79	8

**Table 2**

**Assessment for time to achieve the set target by the scheme**

Criteria	Time - yr	Points
Reduction	3	12
	6	9
	9	6
	12	3
Diversion	1	12
	2	9
	3	6
	4	3

**Table 3**

**Criteria for ranking the schemes**

Category	Points
Poor	1 - 7
Fair	8 - 14
Good	15 - 20

**Table 4****Category and goal of the fifteen schemes reviewed**

Country	Instrument used			Goal of scheme	
	Economic	Regulatory	Incentive based	Reduction	Diversion
Belgium (F. B. MSW)	X				X
Denmark	X				X
Germany (MSW)	X				X
Italy	X				X
Luxemburg	X				X
Sweden (MSW)	X				X
Ireland	X			X	
Germany (green dot)		X			X
Belgium (battery)		X			X
Finland		X			X
Belgium (waste paper and board)		X		X	
Netherlands		X			X
Belgium (Flanders MSW)		X			
Sweden (home composting)			X		X
UK (real nappy)			X	X	

**Table 5****Normalised performance of the 15 schemes**

Country	Amount of waste reduced or diverted (kg/cap/yr)	Normalised amount of waste reduced or diverted (kg/cap/yr)
Belgium ( F. B. MSW)	47	0.1
Denmark	120	0.2
Germany (MSW)	236	0.7
Italy	17	0.04
Luxemburg	32	0.07
Sweden (MSW)	37	0.08
Ireland	4	0.01
Germany (green dot)	ND	ND
Belgium (battery)	ND	ND
Finland	95	0.5
Belgium (waste paper and board)	ND	ND
Netherlands	ND	ND
Belgium (Flanders MSW)	40	0.03
Sweden (home composting)	6	0.01
UK	1,600	5

ND: Not determined.

**Table 6****Assessment of the effectiveness of economic instrument schemes**

Country	Achievement	Time	Total points	Effectiveness
Belgium (F. B. MSW)	6	6	12	Fair
Denmark	6	9	15	Good
Ireland	4	12	16	Good
Italy	2	9	11	Fair
Luxemburg	4	6	10	Fair
Sweden (MSW)	2	6	8	Fair

**Table 7****Assessment of the effectiveness of schemes under the regulatory instrument**

Country	Achievement	Time	Total points	Effectiveness
Belgium (battery)	8	3	11	Fair
Finland	8	9	17	Good
Belgium (waste paper and board)	6	6	12	Fair
Belgium (Flanders, MSW)	6	3	9	Fair



**Table 8**

**Assessment of the effectiveness of incentive based schemes**

Country	Achievement	Time	Total points	Effectiveness
Sweden (home composting)	2	9	11	Fair
UK (real nappy)	8	12	20	Good

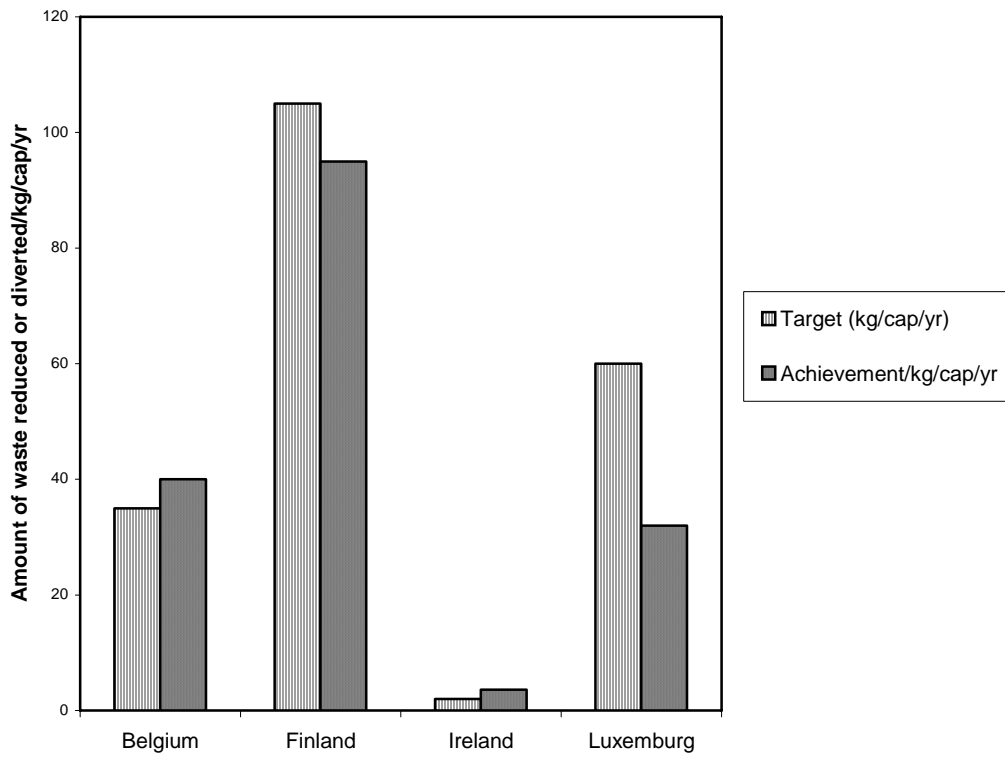
**Table 9****Applicability of the reviewed schemes in UK**

Country	Compatibility with government policy	Corrected effectiveness of scheme	Ease of operation	Public acceptability	Total	Applicability <sup>a</sup>
Belgium (F. B., MSW)	<sup>x</sup>	3	5	5	13	M
Denmark	<sup>x</sup>	3.8	ND	5	8.8	D
Germany (MSW)	<sup>x</sup>	ND	<sup>x</sup>	5	5	D
Italy	<sup>x</sup>	2.8	<sup>x</sup>	5	7.8	D
Luxemburg	<sup>x</sup>	2.5	<sup>x</sup>	5	7.5	D
Sweden (MSW)	<sup>x</sup>	2	<sup>x</sup>	5	7	D
Ireland	<sup>x</sup>	4	5	5	14	M
Germany (Green dot)	5	ND	5	5	15	M
Belgium (battery)	5	2.8	5	5	17.8	R
Finland	5	4.3	5	5	19.3	R
Belgium (waste paper and board)	5	3	5	5	18	R
Netherlands	5	ND	5	5	15	M
Belgium (Flanders, MSW)	<sup>x</sup>	2.3	5	5	12.3	M
Sweden (home composting)	5	2.8	<sup>x</sup>	5	12.8	M
UK (Real Nappy)	5	5	5	5	20	R

<sup>a</sup> R: readily applicable, M: applicable with some modification, D: difficult to apply.

<sup>x</sup> Not conforming with the parameter.

ND: Not determined.



**Figure 1**

**Performance of waste management schemes based on economic instruments in four EU Member States (amount of waste reduction/diversion against set targets)**