Science of the Total Environment 423 (2012) 1–7

Contents lists available at SciVerse ScienceDirect

Science of the Total Environment

journal homepage: www.elsevier.com/locate/scitotenv

# Food waste disposal units in UK households: The need for policy intervention

Eleni Iacovidou, Dieudonne-Guy Ohandja, Nikolaos Voulvoulis *

*Centre for Environmental Policy, Imperial College London, London SW7 2AZ, UK*

ARTICLE INFO

*Article history:*
Received 11 November 2011
Received in revised form 19 January 2012
Accepted 22 January 2012
Available online 6 March 2012

*Keywords:*
Food waste disposal units (FWDs)
Local Authorities
Water industry
Anglian Region
Economic pressures

ABSTRACT

The EU Landfill Directive requires Member States to reduce the amount of biodegradable waste disposed of to landfill. This has been a key driver for the establishment of new waste management options, particularly in the UK, which in the past relied heavily on landfill for the disposal of municipal solid waste (MSW). MSW in the UK is managed by Local Authorities, some of which in a less conventional way have been encouraging the installation and use of household food waste disposal units (FWDs) as an option to divert food waste from landfill. This study aimed to evaluate the additional burden to water industry operations in the UK associated with this option, compared with the benefits and related savings from the subsequent reductions in MSW collection and disposal. A simple economic analysis was undertaken for different FWD uptake scenarios, using the Anglian Region as a case study. Results demonstrated that the significant savings from waste collection arising from a large-scale uptake of FWDs would outweigh the costs associated with the impacts to the water industry. However, in the case of a low uptake, such savings would not be enough to cover the increased costs associated with the wastewater provision. As a result, this study highlights the need for policy intervention in terms of regulating the use of FWDs, either promoting them as an alternative to landfill to increase savings from waste management, or banning them as a threat to wastewater operations to reduce potential costs to the water industry.



## 1. Introduction

The disposal of biodegradable waste to landfill can lead to the formation of landfill gas and leachate which can result in adverse environmental impacts. To control these impacts, the European Union (EU) Landfill Directive (1999/31/EC) came into force and requires all EU member states to reduce the amount of biodegradable waste going to landfill to 75% by 2006, 50% by 2009 and 35% by 2016, based on the waste production levels of 1995 (European Council, 1999). Countries which have been heavily reliant on landfill, such as the UK, have an additional four years to comply with the targets set in this Directive. Therefore, in order to reduce the amount of biodegradable waste going to landfill to 75% by 2010, 50% by 2013 and 35% by 2020, alternatives to landfill are increasingly being considered across the UK (European Council, 1999).

In the UK, Local Authorities (LAs) have the responsibility for managing municipal solid waste, of which a high proportion is biodegradable. To deliver the required landfill diversion targets they have promoted and implemented a wide range of waste management options including kerbside collection and recycling, home and centralised composting, centralised incineration, anaerobic digestion, and the use of food waste disposal units (FWDs) (Defra, 2007).

* Corresponding author. Tel.: +44 2075947459.
*E-mail address:* n.voulvoulis@imperial.ac.uk (N. Voulvoulis).

0048-9697/$ – see front matter © 2012 Elsevier B.V. All rights reserved.
doi:10.1016/j.scitotenv.2012.01.048

The use of FWDs foresees the diversion of food waste from the solid waste stream through grinding with the addition of water for direct discharge as wastewater in the sewers (Evans, 2007; Galil and Shpiner, 2001). Although most LAs would treat household food waste collected as part of the biodegradable fraction or separately, some (LAs) have been encouraging the installation and use of FWDs. As a result, in order to tie up with the recommendations set by LAs, FWDs have recently been installed in new housing developments.

In 2008, in the UK, 5% of households had FWDs (MTP, 2008), an installation rate considered to be the highest amongst the EU member states (EPA, 2008). Although their use is controlled in European countries, being banned in Austria, Belgium and Germany, and regulated locally by municipalities in Italy, France and Sweden, the story is very different outside the EU. The highest installation rate is found in the USA, where 50% of households have FWDs, whereas in Canada, Australia and New Zealand the installation rate of FWDs is about 10%, 12% and 30% of households, respectively (EPA, 2008).

This diversity in installation rates of FWDs is mainly attributed to the belief that the use of these units can be associated with a number of technical and environmental limitations. For that purpose available studies have recently been reviewed to examine the feasibility of their use (Iacovidou et al., in press). In these studies, recommendations on the use of FWDs as a waste management option differ widely and there is widespread uncertainty regarding their potential benefits and impacts to wastewater treatment works. This is mainly because different area-specific characteristics such as water resources, household practices, the condition of the sewerage system and different wastewater treatment processes can affect the viability of FWDs as a waste management option. These characteristics are important factors that must be taken into account before the adoption of FWDs as a wide scale waste management option (Iacovidou et al., in press).

In the UK, waste collection and disposal are not under the same authority as water industry operations and thus the use of FWDs becomes more complicated. This is because the use of FWDs would transfer the responsibility for food waste management from LAs to the water industry. As such, whilst LAs could benefit by reductions in the amount of waste collected, the water industry would be left to deal with the additional costs related to water treatment and distribution, wastewater treatment, and sludge treatment and disposal, without the transfer of the associated revenues.

Based on this supposition and with limited research undertaken in the UK on the potential impacts of the use of FWDs, this paper has evaluated the additional burden to water industry operations in the UK, compared with the benefits and related savings from the reduction in cost of waste collection and disposal to Local Authorities, using the Anglian Region as a case study. Although the methodology can be applied to any region, the Anglian Region was selected because of the availability of data that were provided or adopted from the literature.

## 2. Methods

The Anglian Region, one of the areas with the fastest growing population in the UK, was chosen as a case study. This region was identified by the Environment Agency as the driest region in the UK, with an average of 600 mm of rainfall each year, in contrast to the average 900 mm for the rest of England and Wales (Anglian Water, 2008). Anglian Water is the main provider for water and/or wastewater treatment services in this area (East of England) (Anglian Water, 2008). Based on the latest available data provided by the LAs and Anglian Water, year 2008 was chosen as the base year for calculations and 2035 as the projection year.

To evaluate the additional burden of the use of FWDs from year 2008 to year 2035, three scenarios were investigated. In these scenarios a current, future and hypothetical market installation rate was used to project the FWD penetration in 2035, based on the 2008 average FWD installation rate of 5% (MTP, 2008). The purpose of having these three scenarios was to show the magnitude of large-scale use of FWDs over the current penetration rates (Table 1).

In order to evaluate the benefits resulting from the use of FWDs, a simple economic analysis was undertaken. Cost elements borne by LAs included the collection and disposal of household residual waste. Household residual waste includes the waste that has not been separated for reuse or recycling. Food waste is a fraction of household residual waste and accounts for approximately 36.7% of it. Therefore this type of waste was considered in the analysis. For the water industry, cost elements such as water and wastewater treatment, sewer cleanse and sludge management were considered (Fig. 1).

**Table 1**
Scenarios of FWDs penetration rate.

| Scenario | FWDs penetration rate | | Assumption |
|---|---|---|---|
| | Increase per year (%) | Projected in 2035 (%) | |
| Low | 0.3 | 10 | Market penetration remains stable at current rates (MTP, 2008) |
| Medium | 1 | 24 | Market penetration increases as predicted by MTP (MTP, 2008) |
| High | 15 | 96 | Hypothetical case where FWD are promoted as 'the' waste management option |

The cost of household residual waste collection is largely dependent on the number of households in the Anglian region, whereas the cost of household waste disposal depends on the amount of household residual waste collected. According to that, changes in the fraction of food waste would not create any changes in the cost of waste collection. A reduction in the amount of food waste due to the use of FWD would reduce the amount of household residual waste for disposal, and therefore the associated cost. To calculate this cost, both the amount of household residual waste generated in the Anglian region and the fraction of food waste within it were first calculated. For each FWD penetration rate scenario, the food waste fraction in residual waste was changed and so, as a result, was the amount of household residual waste. The calculated amount of household residual waste collected and the cost value of household residual waste disposal (Table 2) were used to project the cost of household residual waste disposal to LAs in 2035. To calculate the cost of household residual waste collection, the number of households in the Anglian region was first calculated. This number, together with the cost value of household residual waste collection (Table 2), was used to calculate the cost of waste collection in the region. The cost values of household residual waste collection and disposal were based on the 2008 average costs, as estimated on the basis of data collected from LAs in the Anglian region. Increases in the landfill tax and inflation rates in these costs by 2035 were not included in the calculations not only to exclude the inherent uncertainties in these, but also to ensure that all costs are directly comparable. As the UK government has put landfill tax on an escalator from 2008 to 09 until 2014, these calculations provide a conservative estimate. With the annual increase in landfill tax set at £8 per tonne of waste, by 2014 landfill tax will be £80 per tonne in comparison to the £32 per tonne in 2008 that was used as the base year.

The costs of water treatment and distribution, wastewater collection and treatment, and sludge treatment and disposal, were calculated based on water consumption, tonnage of biochemical oxygen demand (BOD), and dry solids (DS) treated in the whole area, respectively (Table 2). Thus, increases in these parameters due to FWDs were used to estimate the additional costs. However, the marginal cost to treat an additional tonne of BOD or DS can be very different, depending on the method used. That is because some wastewater treatment plants can incur relatively small additional costs from BOD increase, whereas others have BOD, suspended solids (SS) or even heavy metal limits that disproportionally affect the marginal costs of an additional volume. In addition, costs associated with sewer cleansing and maintenance, although they constitute a cost to the water industry, were not calculated in the analysis mainly because there are no direct costs associated with the disposal of food waste in the sewer. Therefore it was difficult to accurately estimate how the disposal of food waste would increase these

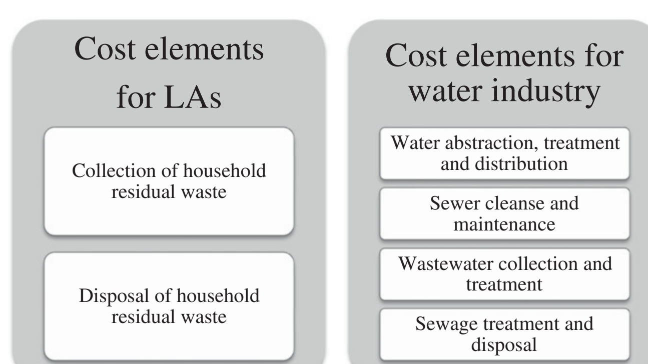


**Fig. 1.** Cost elements used for comparing the LAs savings to the water industry costs.