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Composting & Anaerobic Digestion Association *of* Ireland

Research Report:

The Collectable Source Separated Food and Garden Waste Arising from Households in Ireland

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Table of Contents

Executive Summary

The latest Environment Protection Agency (EPA) Waste Report 2008 has shown that Ireland is 280,000t of Biodegradable Municipal Waste (BMW) short of the first Landfill Directive target due by July 2010. This report reviewed some of the best biowaste collection systems in the European Union (EU) and then they were applied to the Irish situation. This research report estimates the collectable source-separated food and garden waste for each county in Ireland.

Proper management of organic waste needs to be implemented in Ireland. Ireland should follow best practice system in Europe. For example, the Province of Lower Austria has a population of 1.5 million people, comprising 625,000 households, and 573 local districts. The majority of local districts have less than 5,000 people each. Biowaste is managed by home composting, brown bin collection and the collection of garden waste at the kerbside in paper bags, or by people dropping it off at the local civic amenity centre. The collected biowaste is then composted in on-farm composting plants and the farmers use the compost primarily on their own land. With 95% of the organic waste fraction managed in this way, this leaves only 5% organics in the black bin.

The Department of Environment, Heritage and Local Government (DoEHLG) recently published the *International Review of Waste Management Policy* which recommended national legislation in which waste collectors would have to provide a food waste only brown bin collection service to households in Ireland.

The key findings of the report are:

- Source separation schemes can be categorised into two main types of collection schemes:
  a. commingled collection of food and garden waste using a wheelie bin (80 to 240 litres) which is collected either weekly or fortnightly and
  b. bespoke collection of food waste only (excluding garden waste) with small bin/caddies (bins up to around 35 litres or compostable bags of 10 to 20 litres) being collected weekly. In addition, garden waste can be delivered to civic amenity sites or small amounts of garden waste can be collected at the kerbside together with the brown bin in a garden waste paper bag which is additionally charged by the waste collector.
- Based on a number of case studies from European countries with advanced source separation schemes, the collectable food and garden waste from householders in Ireland is estimated to be 642,761 tonnes of BMW per year. The European case studies do not have identical conditions to Ireland. However, they provide good examples of the potential tonnes which could be collected.
- In urban areas (cities with a population of more than 20,000) a reduced capture of around 75kg/Inhabitant of waste could be expected. This would reduce the collectable biowaste from 642,761t to 520,967t.
- Barth *et al.,* (2008) estimated 150 kilogram/inhabitant/year (kg/inh*y) as a realistic mean result. The data determined in this report 152kg/inh*y with a reduced capture in urban areas (123 kg/inh*y) is similar to this reported figure. This supports the findings of this report.

Results and benefits of food waste only small bin schemes are:

- specific collection of food waste keeps bulk density higher, and volume smaller;
- no compaction is needed because the food waste is wet and dense;
- hand picking is possible, implying a much reduced pick-up time and saving money;
- vehicles for food waste may be of a cheaper type (usually small-sized open lorries), since compaction is not needed;
- the foregoing implies a significantly lower cost of the single collection round, which in turn makes it possible to increase its frequency;
- this increases capture of food and garden waste to a significant extent, which in turn reduces the percentage of organics in residual waste;
- consequently, collection of residual waste may be performed at reduced frequency;
- collection of garden waste may be made cheaper, either through a 'green round' at the kerb, but with much reduced frequency (*e.g.* monthly) or with direct delivery at local authority recycling centres, and
- little or no contamination as people cannot hide contamination in the small containers.

This study recommends:

1. Immediate preparation of the national legislation requiring that all collectors who collect household waste to provide a food waste collection service to households.
2. Immediate preparation of the national legislation to ensure that all household waste recycling centres are equipped with facilities for the separate collection of garden waste.
3. Food waste prevention/home composting should be promoted first, and then a brown bin service should be provided to householders, if required.
4. The continuation and development of the EPA's national home composting and food waste prevention programme called *www.stopfoodwaste.ie*
5. Future household brown bin schemes should be provided for food waste only. Garden waste should be home composted or delivered to civic amenity sites. Small amounts of garden waste may be collected at the kerbside together in a separate garden waste paper bag during the summer months. This may be additionally charged by the waste collector. Simultaneous collection with the brown bin will avoid separate transport.
6. A national awareness campaign on the proper use of brown bin should be provided in Ireland. This campaign should provide promotional brochures on how to use the brown bin, and also be available on a national website.
7. Consideration should be given to hiring of "brown bin advisors" who could visit homes and explain the proper use of brown bin. This was conducted in Germany for a period of 1-2 years when source separation was first introduced. Alternatively, a private company could provide this service during the initial period of the roll out of brown bins.

1. Introduction

Based on a number of case studies from European countries with advanced source separation schemes, the collectable food waste and garden waste from householders in Ireland was assessed. The performance of food waste 'small bin up to 35 litres' food waste collection schemes was examined as well.

1.1 Background

The Comptroller and Auditor General[1] noted in his annual report for 2005 that *"there is a significant risk that Ireland will fail to meet the targets set down in the Landfill Directive."* He also highlighted the *"possibility of EU financial penalties arising from any such failure."* It is of the greatest urgency that the DoEHLG implement measures in order to meet the targets.

The DoEHLG published on 19 November 2009 the *International Review of Waste Management Policy* for Ireland. The report commissioned by the Minister for the Environment, Heritage and Local Government examines all aspects of waste management policy, from prevention and minimisation to the management of residual waste.

Key recommendations of the report are:

- Legislation requiring that all collectors who collect household waste provide a food waste collection service to households (either themselves, or through collaborating with other providers), and
- Legislation to ensure that all household waste recycling centres are equipped with facilities for the separate collection of garden waste.

Presently the main instruments in place to achieve Ireland's targets under the EU Landfill Directive are:

- The Minister[2] announced increases to the landfill levy to drive waste from landfills in order to meet challenging EU targets, the first of which occurs in 2010. The levy will increase from €30 per tonne to €50 in 2011, and to €75 in 2012. "*Earlier this year the Government also decided to introduce an incineration levy. While the actual rate of the levy will need to relate to the rates of landfill levy which I have just announced I do envisage that the incineration levy will be in the range of €20 to €38 per tonne,"* the Minister stated.
- Conditions in waste collection permits introduced by some local authorities (*e.g.* Limerick, Clare, Kerry), which mandate that domestic and commercial premises must be provided with a brown-bin service by a certain date.
- Conditions set out in the EPA Technical Guidance document *Municipal Solid Waste: Pre-treatment and Residuals Management,* which will require operators of landfill and incineration facilities to demonstrate, via their waste acceptance policy, that waste accepted at these facilities has been subjected to appropriate pre-treatment. The guidance document will also impose restrictions on the amount of biodegradable waste which can be landfilled.

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1 www.audgen.gov.ie [28/11/2008]

2 Press Release DoEHLG *Gormley Publishes International Review of Waste Management Policy* 19/11/09

- The Food Waste Regulations Statutory Instrument (SI) 508 of 2009[3] aims of ensuring that, as a significant source of food waste arises in the commercial sector; it will be segregated at source for collection. This source-separated material will then be suitable for downstream processing in composting and anaerobic digestion facilities. The SI has not been extended to householders, but is intended to apply to other non-household sources of significant quantities of food waste.

It is timely, with the increased emphasis on incentives and legislation to divert organic waste from landfills, to examine best practice on how to set up a robust source separation collection scheme for food and garden waste.

1.2 Objective of the study

The objectives of the study are to:

- Estimate realistic scenarios for food and garden waste arising from households, and
- Examine the performance of food waste collection schemes.

1.3 Methodology

Overall, the summary of the methodologies used in the report are as follows:

- The report examined the best practice approaches of six source separation collection schemes from Italy, Austria and the United Kingdom (UK).
- The capture rate data (kg of waste per inhabitant per year), from these schemes, was then used and with Census 2006 Irish population data.
- The estimated potential food and garden waste from households, which could be collected, was determined for Ireland.

[3] Waste Management (Food Waste) Regulations SI 508 of 2009.

2. Estimated Potential Source Separated Food and Garden Waste in Ireland

2.1 Estimation of potential food and garden waste by population; data for Ireland multiplied by average waste arising from best practice collection schemes in other EU Countries

One option to estimate the amount of food waste and garden waste in Ireland, which could be collected by source-separation schemes, is by using data from countries which already have well-established source-separation collection schemes. This can be done by using the average waste-arising figures from those established collection schemes and then multiplying the result with the population data for Ireland. This is a method using best available information in order to determine the potential waste arising were collection schemes to be established in Ireland using best-practice experiences already established abroad.

This method was used by Barth *et al.,* (2008) in a European study as part of the *End of Waste Project* for the European Commission. The authors established 150 kg per inhabitant per year as a reliable estimate for the collectable organic fraction of biodegradable municipal waste (OFBMW). Using this baseline figure as the *per capita* waste arising, and multiplied by the CSO population data of 2006, would result in a total biowaste collection potential of approximately 600,000 t/a in Ireland.

Best Practice Collection Schemes

This section shows case studies/scenarios of some well-established source-separation collection schemes for Austria, Italy and the UK. The schemes can be categorised into two main types of collection schemes:

- commingled collection of food and garden waste using a wheelie bin — 80 to 240 litres — which is collected weekly or fortnightly, and
- bespoke collection of food waste only with small weekly-collected receptacles — bins up to ca 35 litres or compostable bags of 10 to 20 litres — in combination with an additional garden waste collection regime involving less frequent collection, kerbside tipping on garden waste campaign dates, shredder service, delivery to civic amenity sites*, etc.*

For this report, six schemes which are representative of best-practice collection schemes for households have been studied. They are as follows:

- **Scenario (1) – Austria/Brown-Bin**: Weekly brown-bin collection scheme for commingled collection of food and garden waste from households and similar institutions. In addition, garden waste can be delivered to civic amenity sites or small amounts of garden waste can be collected at the kerbside together with the brown-bin in a garden waste paper bag which incurs an extra charge from the operator.

- **Scenario (2) – Austria/Small Bin up to 35 Litre**: A 10 to 49 litre bin collection scheme involves a; weekly collection of food only. In addition, garden waste can be delivered to civic amenity sites or small amounts of garden waste can be collected at the kerbside together with the brown-bin in a garden waste paper bag which incurs an extra charge from the operator.

- **Scenario (3) – Italy/low** *i.e.* low capture of garden waste: A small bin up to 35 litre collection scheme with compostable bags as a liner at minimum weekly bespoke collection of food waste only and a separate garden waste collection regime. There are lower captures than in the scenario *(4)–Italy/high* due to a higher proportion of home composting of garden waste and own-composting by some professional gardeners.

- **Scenario (4) – Italy/high***, i.e.* high-capture of garden waste: A small bin up to 35 litre collection scheme with compostable bags as a liner in which there is, at minimum, a weekly bespoke collection of food waste only and a separate system for garden waste.

- **Scenario (5) – UK/ Small Bin up to 35 Litre**: This is a small bin up to 35 litre or bag collection scheme involving a weekly bespoke collection of food waste only. In addition, garden waste can be delivered to civic amenity sites or small amounts of garden waste can be collected at the kerbside together with the brown-bin in a garden waste paper bag which incurs an extra charge from the operator.

- **Scenario (6) – UK/Brown-Bin**: This is a fortnightly brown-bin collection scheme for commingled collection of food and garden waste from households and similar institutions. In addition, garden waste can be delivered to civic amenity sites or small amounts of garden waste can be collected at the kerbside together with the brown-bin in a garden waste paper bag which incurs an extra charge from the operator.

Table 1 summarises organic waste quantities resulting from the case studies/scenarios in Austria, Italy and the UK. It is important to note that these figures always relate to the entire population in the covered collection area. Examples of best performances show captures of 250kg/household with a Local Authority area of mixed rural and urban housing. However, in densely-populated urban zones total capture rates may decrease to 70 kg/inh*a (kilogram per inhabitant *per year*).

Figure 1. Paper bag used to collect garden waste at the kerbside in Bath, UK

Table 1: Summary of the Case Studies/Scenarios in Austria, Italy & UK of Capture Rates [kg/Inh*a] Food and Garden Waste

Compostable Bag / Small Bin up to 35 Litre scheme kg/inh*a bespoke collection of food waste						
	Food Waste		Garden waste		Food Waste + Garden waste	
Example 'Freistadt'						
urban	114		134		248	
rural	26		111		136	
Example 'Italy-low' [1]	with garden	without garden	with garden	without garden	with garden	without garden
urban	80	80	120	20	200	100
rural	70	80	90	15	160	95
Example 'Italy-high' [2]						
urban	80	80	175	75	255	155
rural	70	80	110	30	180	110
Example 'UK-Bio-Bag'						
urban	50		50		100	
rural	50		65		115	
The average kg/inh*a for urban area is	**80.7[4]**		**95.7**		**176.4**	
The average kg/inh*a for rural area is	**62.7**		**70.2**		**132.9**	
Brown-Bin scheme Commingled collection of Food and Garden waste						
	Brown-Bin		Garden waste		Brown-Bin + Garden waste	
Example 'Gaenserndorf'	with garden	without garden	with garden	without garden	with garden	without garden
urban	180	45	150	50	330	95
rural	120	45	75	75	195	120
Example 'UK-Brown-Bin'						
urban	100		[3] 0		100	
rural	130		[3] 0		130	
Example Linz						
urban	60		10		70	
The average kg/inh*a for urban area is	**96.25**		**52.5**		**148.75**	
The average kg/inh*a for rural area is	**98.33**		**50**		**148.33**	

1) 'Italy-low': example with low garden waste captures
2) 'Italy-high': example with high garden waste captures
3) Additional garden and landscaping waste collection to the brown-bin is not provided
4) Example of a calculation is 114+80+80+50+80+80 / 6= 80.7

For all scenarios, it is possible to deliver garden waste to civic amenity sites and composting plants. Also in the Austrian scenarios, small amounts of garden waste can be delivered at the kerbside together with the brown-bin in a garden waste paper bag, which incurs an extra charge from the operator. In the Italian scenarios, kerbside collection of garden waste is provided at reduced collection frequencies, *e.g.,* once a month during the summer) and often under a *pay-as-you-throw* regime.

It is assumed in all six scenarios that material collected also includes some commercial waste, because typically small shops such as greengroceries or food markets, small canteens, and small restaurants are also included in the domestic brown-bin collection scheme.

Table 2 shows the population for Ireland based on the rural/urban divide. These population figures will be used in the calculations, in the following Tables 3-6, in which they will be multiplied by the data from the case studies/scenarios, in order to provide an accurate estimation of the potential food and garden waste arising.

Table 2: Urban and Rural Population of Ireland

County/Region	Urban	Rural	Total
Leinster	**1,724,936**	**570,187**	**2,295,123**
Carlow	24,306	26,043	50,349
Dublin	1,160,501	26,675	1,187,176
Kildare	122,016	64,319	186,335
Kilkenny	30,942	56,616	87,558
Laois	27,165	39,894	67,059
Longford	8,836	25,555	34,391
Louth	71,640	39,627	111,267
Meath	85,705	77,126	162,831
Offaly	30,114	40,754	70,868
Westmeath	37,604	41,742	79,346
Wexford	45,612	86,137	131,749
Wicklow	80,495	45,699	126,194
Munster	**608,126**	**565,214**	**1,173,340**
Clare	43,391	67,559	110,950
Cork	295,686	185,609	481,295
Kerry	49,233	90,602	139,835
Limerick	95,613	88,442	184,055
North Tipperary	24,616	41,407	66,023
South Tipperary	33,512	49,709	83,221
Waterford	66,075	41,886	107,961
Connacht	**171,765**	**332,356**	**504,121**
Galway	99,756	131,914	231,670
Leitrim	2,595	26,355	28,950
Mayo	35,678	88,161	123,839
Roscommon	14,334	44,434	58,768
Sligo	19,402	41,492	60,894
Ulster	**69,486**	**197,778**	**267,264**
Cavan	16,913	47,090	64,003
Donegal	36,585	110,679	147,264
Monaghan	15,988	40,009	55,997
State total	**2,574,313**	**1,665,535**	**4,239,848**

Source: Census 2006; Central Statistics Office Ireland, CSO www.cso.ie/Census [9/10/2009]

According to the Central Statistics Office, population in the Aggregate Town/Urban Area[4] is defined as those persons living within population clusters of 1,500 or more inhabitants. The population residing in all areas outside clusters of 1,500 or more inhabitants is classified as belonging to the Aggregate Rural Area.

The following Table 3 shows the extrapolation of the six scenarios to the Irish situation.

The Table 3 shows that:

- From the six scenarios, the mean kg/inhabitant/year for food waste is 84.5kg
- From the six scenarios, the mean kg/inhabitant/year for garden waste is 67.1kg
- From the six scenarios, the mean kg/inhabitant/year for food and garden waste is 152kg. This last figure will be used in the calculations in the following Tables 4, 5 & 6.

[4] Appendix 2, CSO Census 2006

Table 3 Extrapolation of the Food and Garden Waste Data from the Six Case Studies/Scenarios to the Irish Situation

Scenario	kg/inh for the scenario	Total potential tonnes for the Irish situation
Small Bin up to 35 Litre/Compostable Bag scheme Bespoke collection of Food Waste		
Rural Food Waste	62.7	
Urban Food Waste	80.7	
Rural Garden Waste	70.2	
Urban Garden Waste	95.7	
Total Urban	176.4	454,109
Total Rural	132.9	221,350
Total (Urban + Rural)		**675,458**
BROWN-BIN scheme Commingled collection of Food and Garden Waste		
Rural Food Waste	98.33	
Urban Food Waste	96.25	
Rural Garden Waste	50	
Urban Garden Waste	52.5	
Total Urban	148.75	382,929
Total Rural	148.33	247,049
Total (Urban + Rural)		**629,978**
MEAN of Brown Bin + Small Bin up to 35 Litre/Compostable Bag scheme		
Food Waste Mean kg/inh/year	84.50[1]	
Garden waste Mean kg/inh/year	67.1	
Mean kg/inh/year	**152**	

1 Calculated by 62.7+80.7+98.33+96.25=337.98/4 = 84.5

Table 3 indicates a considerable difference in organic waste arising, between 629,978 and 675,458 t/a, depending upon the system of collection in use.

In this report's assessment, the authors have assumed a complete countrywide implementation of domestic source-separation scheme for both food and garden waste. The organic waste capture of 152 kg, *cf.* Table 3, is the average result from the presented six scenarios in Table 1 relative to the whole population of Ireland and includes the typical proportion of home composting.

For source-separated brown-bin collection schemes, well-documented statistics exist. In contrast, garden waste estimates include far more uncertainties. The reasons are:

- Exact figures for the rate of home composting are hardly available;
- The capture rate from private gardens depends greatly upon the education and commitment to home composting and gardening;

- Where garden waste is delivered to civic amenity sites it cannot be distinguished between private, commercial and municipal sources;
- The extent to which Local Authority parks/garden divisions compost their own garden waste within their own department, and
- In many cases, a certain amount of potential garden wastes are disposed off elsewhere, such as with dumping, direct agricultural use as mulch, and/or by biomass power plants.

Table 4 **The Potential Tonnage of Food Waste in Ireland, if We Were to Extrapolate the Mean of 84.5 kg/inhabitant from the Six Case Studies Schemes from Austria, Italy and the UK and Multiply by the Respective Populations, Urban and Rural, in Ireland.**

	tonnes/inh/year		
County / Region	Urban	Rural	Total
Leinster	**145,757**	**48,181**	**193,938**
Carlow	2,054	2,201	4,254
Dublin	98,062	2,254	100,316
Kildare	10,310	5,435	15,745
Kilkenny	2,615	4,784	7,399
Laois	2,295	3,371	5,666
Longford	747	2,159	2,906
Louth	6,054	3,348	9,402
Meath	7,242	6,517	13,759
Offaly	2,545	3,444	5,988
Westmeath	3,178	3,527	6,705
Wexford	3,854	7,279	11,133
Wicklow	6,802	3,862	10,663
Munster	**51,387**	**47,761**	**99,147**
Clare	3,667	5,709	9,375
Cork	24,985	15,684	40,669
Kerry	4,160	7,656	11,816
Limerick	8,079	7,473	15,553
North Tipperary	2,080	3,499	5,579
South Tipperary	2,832	4,200	7,032
Waterford	5,583	3,539	9,123
Connacht	**14,514**	**28,084**	**42,598**
Galway	8,429	11,147	19,576
Leitrim	219	2,227	2,446
Mayo	3,015	7,450	10,464
Roscommon	1,211	3,755	4,966
Sligo	1,639	3,506	5,146
Ulster	**5,872**	**16,712**	**22,584**
Cavan	1,429	3,979	5,408
Donegal	3,091	9,352	12,444
Monaghan	1,351	3,381	4,732
State total	**217,529**	**140,738**	**358,267**

Specific waste captures (t/inh*a) x CSO 2006 population figures

Table 5 **The Potential Tonnage of Garden Waste in Ireland if We Were to Extrapolate the Mean Results from the Six Reference Schemes from Austria, Italy and the UK and Multiply by the Respective Populations, Urban and Rural, in Ireland.**

	tonnes/inh/year		
County / **Region**	**Urban**	**Rural**	**Total**
Leinster	**115,743**	**38,260**	**154,003**
Carlow	1,631	1,747	3,378
Dublin	77,870	1,790	79,660
Kildare	8,187	4,316	12,503
Kilkenny	2,076	3,799	5,875
Laois	1,823	2,677	4,500
Longford	593	1,715	2,308
Louth	4,807	2,659	7,466
Meath	5,751	5,175	10,926
Offaly	2,021	2,735	4,755
Westmeath	2,523	2,801	5,324
Wexford	3,061	5,780	8,840
Wicklow	5,401	3,066	8,468
Munster	**40,805**	**37,926**	**78,731**
Clare	2,912	4,533	7,445
Cork	19,841	12,454	32,295
Kerry	3,304	6,079	9,383
Limerick	6,416	5,934	12,350
North Tipperary	1,652	2,778	4,430
South Tipperary	2,249	3,335	5,584
Waterford	4,434	2,811	7,244
Connacht	**11,525**	**22,301**	**33,827**
Galway	6,694	8,851	15,545
Leitrim	174	1,768	1,943
Mayo	2,394	5,916	8,310
Roscommon	962	2,982	3,943
Sligo	1,302	2,784	4,086
Ulster	**4,663**	**13,271**	**17,933**
Cavan	1,135	3,160	4,295
Donegal	2,455	7,427	9,881
Monaghan	1,073	2,685	3,757
State total	**172,736**	**111,757**	**284,494**

Specific waste captures (t/inh*a) x CSO 2006 population figures]

Table 6 Summary of Potential Organic Waste Estimated in Tables 4 and 5: (1) Food Waste (2) Garden Waste and (3) Total Amounts from Households and Similar Institutions for each County and Region [tonnes]*

County / Region	Food Waste	Garden Waste	Total
Leinster	**193,938**	**154,003**	**347,941**
Carlow	4,254	3,378	7,633
Dublin	100,316	79,660	179,976
Kildare	15,745	12,503	28,248
Kilkenny	7,399	5,875	13,274
Laois	5,666	4,500	10,166
Longford	2,906	2,308	5,214
Louth	9,402	7,466	16,868
Meath	13,759	10,926	24,685
Offaly	5,988	4,755	10,744
Westmeath	6,705	5,324	12,029
Wexford	11,133	8,840	19,973
Wicklow	10,663	8,468	19,131
Munster	**99,147**	**78,731**	**177,878**
Clare	9,375	7,445	16,820
Cork	40,669	32,295	72,964
Kerry	11,816	9,383	21,199
Limerick	15,553	12,350	27,903
North Tipperary	5,579	4,430	10,009
South Tipperary	7,032	5,584	12,616
Waterford	9,123	7,244	16,367
Connacht	**42,598**	**33,827**	**76,425**
Galway	19,576	15,545	35,121
Leitrim	2,446	1,943	4,389
Mayo	10,464	8,310	18,774
Roscommon	4,966	3,943	8,909
Sligo	5,146	4,086	9,232
Ulster	**22,584**	**17,933**	**40,517**
Cavan	5,408	4,295	9,703
Donegal	12,444	9,881	22,325
Monaghan	4,732	3,757	8,489
State totals	**358,267**	**284,494**	**642,761**

* Please note that the presented data models include:

a) Participation level in home composting

b) A categorisation of counties according to CSO statistics and not by regional Waste Management Plans.

Table 6 is the total amount of the estimates of organic waste collected first via food waste and secondly via garden waste in tonnes from households for each county and region. This shows that a possible 642,761t of food and

garden waste could be collected. From the six scenarios examined, the mean kg/inhabitant/year for food and garden waste is 152kg.

Reduced Capture Rates in Urban Areas

When examining domestic biowaste captures in densely-populated urban areas, the average collection rates are often lower. Examples of this can be found is two Austrian cities Graz and Linz, with ca 70 to 80 kg/inh*a . Data on waste arising may vary with specific settlement structures and socio-economic backgrounds. Since these figures represent a specific urban and partly industrialised situation, they cannot be taken as reference for the whole country.

Nevertheless, it is justified to apply this experience to urbanised areas in Ireland. Therefore, assuming an urban reduction collection rate of 75 kg/inh*a instead of a mean of 152 kg/inh*a, the nationwide result is reduced from 642,761t to 520,967t per year. Table 9 explains how this was calculated, with a lower weighting of 75 kg/inh only applied to 'urban' populations, and takes account the fact that in urban areas with population densities of greater than 20,000 inhabitants a reduced capture rate of 75 kg/inh*a was applied.

Table 7 shows the following:

- Irish cities with a population of more than 20,000;
- Population of the individual cities multiplied by the average potential waste arising per inhabitant;
- The mean weight of 152 kg/inh*a is based on the mean of the six case studies/scenarios outlined in Table 8;
- Reduction of potential waste for each individual city using a collection capture of 75kg/inh*a, and
- Total estimated organic waste arising for each city.

Table 7 Estimated Reduction of Organic Waste Captures in Densely-Populated Areas with an Assumed Collection Rate of 75 kg/inh*a

County	City/Town	Population	Waste arising based on 152kg/inh [1)]	Waste arising based on 75kg/inh
Dublin	Dublin area	1,187,176	179,976	89,038
Louth	Dundalk	29,037	4,402	2,178
Meath	Navan	21,141	3,205	1,586
Meath	Drogheda	28,973	4,392	2,173
Wicklow	Bray	27,041	4,099	2,028
Clare	Ennis	20,142	3,054	1,511
Cork	Cork City	119,418	18,104	8,956
Kerry	Tralee	20,288	3,076	1,522
Limerick	Limerick City	52,539	7,965	3,940
Waterford	Waterford City	45,748	6,935	3,431
Galway	Galway City	72,414	10,978	5,431
Totals		**1,623,917**	**246,186**	**121,794**

Tables 4, 5 and 6 show the potential tonnes of food and garden waste respectively in Ireland were we to extrapolate the mean results from the six brown-bin case study schemes in Austria, Italy and the UK.

The ranges of collectable organic waste resulting from all scenarios extrapolated from the six brown-bin case study schemes from Austria, Italy and the UK are summarised in Table 8.

Table 8 Summary of the Estimation of Organic Waste from Households in Ireland

Scenario for Ireland	Tonnes
Mean scenario for Ireland	642,761t
Reduced scenario for cities > 20,000 inhabitants	121,794t
Adjusted Scenario for Ireland after adjusting for the reduced capture for cities > 20,000 inhabitants	520,967t
The mean kg per inhabitant from the six reference schemes is 152 kg.	
The mean kg per inhabitant from the six scenarios after adjustment for reduced capture for cities > 20,000 inhabitants is 123kg.	

2.2 Summary of total potential food and garden waste in Ireland

Table 9: Summary List with the Collectable Part of Source Separated Food and Garden Waste from all Relevant Origins

County Region	Food waste	Garden waste	Total organic BMW waste	
	Full implementation: mean specific capture rate = 152 kg/Inh*a			*Reduced capture in urban zones [75 kg/Inh*a]*[1]
Leinster	**193,938**	**154,003**	**347,941**	**248,869**
Carlow	4,254	3,378	7,633	7,633
Dublin	100,316	79,660	179,976	89,038
Kildare	15,745	12,503	28,248	28,248
Kilkenny	7,399	5,875	13,274	13,274
Laois	5,666	4,500	10,166	10,166
Longford	2,906	2,308	5,214	5,214
Louth	9,402	7,466	16,868	14,644
Meath	13,759	10,926	24,685	20,846
Offaly	5,988	4,755	10,744	10,744
Westmeath	6,705	5,324	12,029	12,029
Wexford	11,133	8,840	19,973	19,973
Wicklow	10,663	8,468	19,131	17,060
Munster	**99,147**	**78,731**	**177,878**	**158,105**
Clare	9,375	7,445	16,820	15,277
Cork	40,669	32,295	72,964	63,817
Kerry	11,816	9,383	21,199	19,645
Limerick	15,553	12,350	27,903	23,878
North Tipperary	5,579	4,430	10,009	10,009
South Tipperary	7,032	5,584	12,616	12,616
Waterford	9,123	7,244	16,367	12,863
Connacht	**42,598**	**33,827**	**76,425**	**70,878**
Galway	19,576	15,545	35,121	29,574
Leitrim	2,446	1,943	4,389	4,389
Mayo	10,464	8,310	18,774	18,774
Roscommon	4,966	3,943	8,909	8,909
Sligo	5,146	4,086	9,232	9,232
Ulster	**22,584**	**17,933**	**40,517**	**40,517**
Cavan	5,408	4,295	9,703	9,703
Donegal	12,444	9,881	22,325	22,325
Monaghan	4,732	3,757	8,489	8,489
State total	**358,267**	**284,494**	**642,761**	**518,369**
kg/Inh*a	84.5	67.1	152	**123**

1. Reduced captures for town >20,000 people in Table 14 are subtracted from relevant figures.

Table 9 is a summary of the collectable part of source separated food and garden waste from household sources.

Table 9 shows the total amount of potential food and garden waste from:

- The amount of food waste from households,
- The amount of garden waste provided separately from brown-bin collection from households and similar institutions, public greens and material delivered to civic amenity sites or composting facilities,
- Taking into consideration a reduced capture rate for organic waste in urban areas and

In total nationally there is a potential 518, 369 tonnes of source separated organic waste available.

This national figure only represents an accurate estimation if source separation is offered throughout the country, including consistent treatment of garden waste originating from publicly and commercially maintained garden and park estates. On a local basis and for a more detailed evaluation three factors may considerably influence the effective collection results. These are

- The proportion of households participating in home composting,
- The settlement and housing structure or the private garden area respectively and
- The type of collection scheme offered for food waste and garden waste from private households (size of collection bins, collection frequency, etc.).

Barth *et al.,* (2008) reported as a realistic mean result on national scale which has been estimated with 150kg/Inh*y. The data determined in this report 152g kg/Inh*y with a reduced capture in urban areas (123 kg/Inh*y) is similar to this reported figure.

Figures 2 to 3 show photographs of the typical methods of the collection of organic waste in Austria. Figure 4 shows the small food waste bins used in the UK.

Figure 2: Food waste containers and paper bags to collect garden/landscaping waste

Figure 3: Garden waste dropped off at a recycling centre

Figure 4: Small bin up to 35 litre food waste containers awaiting collection in Calderdale UK (Source WRAP)

3. Typical Performance of Food Waste Collection Schemes

There is increasing appreciation of the collection model of food waste only small bins up to 35 litre schemes with garden/landscaping waste collected less frequently on a different collection round. This model was originally designed in Southern Europe.

This approach addresses operational problems caused by commingled collection food and garden brown bins, which in principle would require:

- a high frequency (to tackle nuisance caused by long-lasting retention of food waste by households), and
- larger size receptacles — to tackle the bulky nature of garden waste — which in turn implies mechanical loading into packer trucks (Figure 5).

Figure 5: Collection of brown bin using mechanical loading into a packer truck in Armagh

All of this implies a remarkably higher cost of the single collection round. This may and typically does cause a comparatively low frequency for collection, which is typically run on alternate weeks (AWC = alternate week collection). In turn, reduced frequencies tend to keep a high capture of garden waste, which is promoted by large volumes available at the kerb with wheelie bins, but which impair captures of food waste to a great extent, since food waste tends to be disposed of "*in the next bin to be emptied*" (and this is mixed garbage, every other time). Consequently, collection of mixed garbage (residual waste) itself must be kept comparatively expensive (frequencies of collection) because of high percentages of food waste it still contains.

The foregoing operational issues have been addressed by means of a separate, 'bespoke' collection of food waste by means of small-sized receptacles (small bins, normally ranging from 10 to 35 litres).

Results and benefits of food waste only small bins up to 35-litre scheme are:

- specific collection of food waste keeps bulk density higher, and volume smaller
- hand-picking is possible, implying a much reduced pick-up time and saving money,

- vehicles for food waste may be of a cheaper type (usually small-sized open lorries), since compaction is not needed (see Appendix 1),
- the foregoing implies a significantly lower cost of the single collection round, which in turn makes it possible to increase its frequency,
- this increases capture of food and garden waste to a significant extent, which in turn reduces the percentage of organics in residual waste,
- consequently, collection of residual waste may be performed at reduced frequency,
- collection of garden waste may be made cheaper, either through a 'green round' at the kerb, but with much reduced frequency (*e.g.* monthly) or with direct delivery to local authority recycling centres, and
- little or no contamination as people cannot hide contamination in the small containers.

Figure 6: Food waste collection in Kingston upon Thames, UK using a small vehicle (Source: WRAP)

Remarkably, the less convenient and thus decreased collection of garden waste results into enhanced participation in home composting and reduces total deliveries of garden waste at the kerbside brown bin. Garden waste has been blamed for the sharp increase in waste arising in many districts across Europe, when a frequent wheelie bin collection is provided. The general result tends to be a reduced cost for collection of biowaste on the whole, higher diversion from residual waste, and an achievement of high recycling rates with no concurrent increase in waste arising — which is often a hidden benefit of such systems (Hogg *et al*., 2007).

As Ireland is at an early stage of introducing brown bins, the possible implementation of a 'small bin up to 35 litre' system for the collection of food waste is possible. There are pilot schemes currently in use in the UK, where a specific funding and a research programme was promoted by the Waste and Resources Action Programme (WRAP), and rolled out to 18 Local Authorities (WRAP, 2008). In recent times, the number of food waste only collection has increased. In the UK alone, there are 78 local authorities providing food waste only collection and 70 combined food and garden waste. In Ireland, Belfast City Council has provided 9,000 households with a food waste only collection using small bins.

The UK schemes are still in operation and are affected by many local conditions and operational/regulatory constraints, which may need to be overcome in the near future. These constraints in the UK include factors such as the collection frequencies for residual waste, not using compostable bags as liners in the bins. These constraints should be considered for the Ireland situation. Thus, the data used reflect the more 'mature' schemes and ongoing trends. The authors have also reported on typical/average performances in Italian schemes, where

already some 2,000 local authorities (or so) out of 8,000 have implemented such schemes which gives consistent statistical grounds to build on. Table 11 reports on summary performances. For UK conditions, the following factors are assumed (albeit not generally used in pilot schemes). These represent the 'ongoing trend' for optimisation of performances and costs, *i.e.*

- collection of food waste with small bins up to 35 litres, and compostable bags as a lining system, once a week,
- collection of garden waste with reduced frequency at the kerb and/or delivery at recycling centres, and
- collection of residual waste on alternate weeks, which increases diversion of food waste into the proper 'collection stream'.

Table 11: Typical / Average Performance Data of Segregated Collection of Food Waste, Garden Waste in Italy and the UK

	Italy	**UK**
Local authorities	ca. 2,000	18
Inhabitants	18 million	92,000 households
Collection scheme	door-to-door bucket collection of food waste garden waste collected through wheelie bins or delivered to civic amenity sites	door-to-door bucket collection of food waste garden waste collected at the kerb though bins or sacks, additional delivery to civic amenity sites
Specific food waste collection [kg/inh*a]	70-80 kg	50 kg
Specific garden waste collection (includes deliveries by professional gardeners) [kg/inh*a]	High-rises: 20-80 kg Houses with gardens: 85-175 kg	50-65 kg
Total food and garden waste collection [kg/inh*a]	110-255 kg	100-115 kg

At a glance, performance of UK schemes, albeit 'filtered/upgraded' in light of ongoing trends, still show comparatively low captures which may be decreased, relative to Italy, due to some or all of:

- still unconsolidated systems/behaviours (which impairs above all captures of food waste),
- lower percentages of biowaste due to a higher reliance on 'convenience food' (again, impairing captures of food waste),
- more diffused tradition for home composting (markedly decreasing captures of garden waste), and
- own management of garden waste — delivering directly to compost sites. This aspects escapes capture statistics, although it does enter the 'composting system' again afterwards.

3.1 Factors Which Affect Separate Collection Schemes

A successful separate collection system for biowaste depends upon various factors. An important aspect is the understanding and acceptance of the system by all parties involved. For instance, for the general public, separate collections must be convenient to handle, clean and avoids any odours. In order to achieve this, they must follow best practice in collection schemes procedures. This includes for example:

- Collection frequency,
- Type and size / volume of collection bins and receptacles (*e.g.* small bins up to 35 litres and compostable bags for food waste collection),
- ca. 100 litre paper/wax bags for fine garden waste, and
- Collection of bulky garden waste or access to local civic amenity sites to drop off the garden waste.

There has to be a clear message defining the type of collection system and what it is it trying to achieve. Besides the diversion of organic waste from landfills, a key objective is the production of a high quality compost product. This will only be achieved if the composting process is managed by a compost quality assurance scheme.

Lessons can be learnt from examples in many European countries where composting began solely with a view to managing waste and not to the production of quality compost products. Very often, this has resulted in large amounts of compost with no developed markets.

From the authors' own experience in advanced biowaste management, factors which effect the waste capture rate for biowaste include;

1. Collection scheme operation:

a. Whether it includes segregated collection of food waste in small bins or not,
b. Whether supplementary garden waste collection is available and rate of supplementary collection (weekly, monthly, on demand),
c. Whether kerbside offer collection for bulky garden waste (*e.g.* 4 times per year),
d. Whether garden waste is delivered by operators to collection points,
e. Whether garden waste is delivered to civic amenity sites,
f. Whether brown bin allows co-mingled collection of food waste and garden waste,
g. The volume of bins, frequency of collection, density of housing and gardens,
h. The 'decentralisation' or individual management of garden waste by public parks and local authority areas, and
i. Waste charge system for residual waste and organic waste collection and treatment.

2. Awareness

A secondary — but important — effect is the awareness of the population, which results in a developed commitment and discipline in all aspects of home composting and separate collection behaviour.

A national awareness campaign on the proper use of brown bin should be provided in Ireland. This campaign should provide promotional brochures on how to use the brown bin, a national website. Consideration should be given to hiring of 'brown-bin advisors' who could visit homes and explain the proper use of brown bin. This was conducted in Germany for a period of 1-2 years when source separation was first introduced. Alternatively, a private company could provide this service during the start of the provision of brown bin service.

Figure 7: Contamination tag, Waveney trial (Source: WRAP)

Good Practice Tip: Nipping contamination in the bud

One of the WRAP trials found high rates of contamination (up to 40% of containers) in the less affluent areas during the first week of the food waste collection trial. Effective and increased levels of communication – use of contamination tags explaining why containers had not been collected backed up with door-to-door canvassing, reduced contamination to a negligible level almost immediately (WRAP, 2009).

Table 12 provide a summary on factors influencing the acceptance of source separation and composting of biowaste.

Table 12: Factors Influencing the Sustainability and Acceptance when Introducing Source Separation and Composting of Biowaste

Point of event	Activity / Feature	Remarks
Collection	Type of materials collected	• Differentiated collection schemes for food waste and garden waste brown bin systems • A differentiated collection for food waste comprises some important advantages: specific adaptation of volume and collection frequency to the relative constant food waste production and the high seasonal variation of garden waste per household
	Frequency	• Depends on the season (summer/winter), size of collection volume relative to settlement structure (with or without garden?) and type of material collected (food waste only?)
	Type of collection bins	• The higher the volume the more bulky garden waste • Small receptacles designed for *e.g.* the weekly collection of food waste can be collected by hand-picking and open lorries which saves incremental collection time and costs as compared to wheel bin/compaction truck schemes
	Locality of collection	• Door-to-door collection best performance (high purity; high recycling rates) for food waste and commingled kitchen/garden collection systems • Road container collection; increases impurities for food waste and mixed collection systems; reduces overall captures of organic household waste
	Type of trucks	• Rotopress less suitable for food waste (hindrance of pre-sorting of impurities; increased press water) • Bulk trucks with/without compaction • Open lorries or trailers for hand-picking or with hydraulic emptying systems
	Information, support of the public	• Regular encouragement for home composting (leaflets, seminars, articles, compost parties, information centre, *etc.*) • Regular information to inhabitants about what and how they should do the source separation in the household • Support with collection logistics (*'bio buckets'* for households, compostable bags (paper or compostable bags) • Regular information about the environmental and economic value of source separation
Treatment	Location of composting plant	• Principle: There is little or no nuisance caused by the plant to neighbours (e.g. odour, bioaerosols, 'flying plastics'); minimum distance from permanent residential areas and permanent working places
	Technology	• 'Best practice' for all systems of composting in the frame of a Quality Management system: • Complete and documented receipt control • Immediate treatment of fresh, easily biodegradable source materials • Flexible and controlled moisture, temperature (sanitation) and odour management • Ligneous structure material storage for flexible mixing to the best carbon to nitrogen (C/N) level • Standards for quality orientated production • Controlled collection, treatment and use of drainage water • External control system by a Quality Assurance System (QAS)
Marketing and use		• Third-party certification of compost products within QAS (quality label) • Differentiated product lines and information of customer groups (private gardens, landscaping, land reclamation, agriculture, horticulture (non-food/food)) • Offering compost blends and compost based substrates for the end use (potting soil, greens, sports ground, golf course*, etc.)*

4. Conclusions

The key findings of the report are:

- Source separation schemes can be categorised into two main types of collection schemes:
  a. commingled collection of food and garden waste using a wheelie bin (80 to 240 litres) which is collected either weekly or fortnightly and
  b. bespoke collection of food waste only (excluding garden waste) with small bin/caddies (bins up to around 35 litres or compostable bags of 10 to 20 litres) being collected weekly. In addition, garden/landscaping waste can be delivered to civic amenity sites or small amounts of garden/landscaping waste can be collected at the kerbside together with the brown bin in a garden/landscaping waste paper bag which is additionally charged by the waste collector.
- Based on a number of case studies from European countries with advanced source separation schemes, the collectable food waste and garden waste from householders in Ireland is estimated to be 642,761 tonnes of BMW per year. The European case studies do not have identical conditions to Ireland. However, they provide good examples of the potential tonnes which could be collected.
- In urban areas (cities with a population of more than 20,000) a reduced capture of around 75kg/Inhabitant of waste could be expected. This would reduce the collectable biowaste from 642,761t to 520,967t.
- Barth *et al.,* (2008) estimated 150 kilogram/inhabitant/year (kg/inh*y) as a realistic mean result. The data determined in this report 152kg/inh*y with a reduced capture in urban areas (123 kg/inh*y) is similar to this reported figure. This supports the findings of this report.

Results and benefits of food waste only small bin schemes are:

- specific collection of food waste keeps bulk density higher, and volume smaller,
- no compaction is needed because the food waste is wet and dense
- hand picking is possible, implying a much reduced pick-up time and saving money,
- vehicles for food waste may be of a cheaper type (usually small-sized open lorries), since compaction is not needed,
- the foregoing implies a significantly lower cost of the single collection round, which in turn makes it possible to increase its frequency,
- this increases capture of food and garden waste to a significant extent, which in turn reduces the percentage of organics in residual waste,
- consequently, collection of residual waste may be performed at reduced frequency,
- collection of garden waste may be made cheaper, either through a ‘green round’ at the kerb, but with much reduced frequency (*e.g.* monthly) or with direct delivery at local authority recycling centres, and
- little or no contamination as people cannot hide contamination in the small containers.

5. Recommendations

This study recommends:

1. Immediate preparation of the national legislation requiring that all collectors who collect household waste to provide a food waste collection service to households.
2. Immediate preparation of the national legislation to ensure that all household waste recycling centres are equipped with facilities for the separate collection of garden waste.
3. Food waste prevention/home composting should be promoted first, and then a brown bin service should be provided to householders, if required.
4. The continuation and development of the EPA's national home composting and food waste prevention programme called *www.stopfoodwaste.ie*
5. Future household brown bin schemes should be provided for food waste only. Garden waste should be home composted or delivered to civic amenity sites. Small amounts of garden waste may be collected at the kerbside together in a separate garden waste paper bag during the summer months. This may be additionally charged by the waste collector. Simultaneous collection with the brown bin will avoid separate transport.
6. A national awareness campaign on the proper use of brown bin should be provided in Ireland. This campaign should provide promotional brochures on how to use the brown bin, and also be available on a national website.
7. Consideration should be given to hiring of "brown bin advisors" who could visit homes and explain the proper use of brown bin. This was conducted in Germany for a period of 1-2 years when source separation was first introduced. Alternatively, a private company could provide this service during the initial period of the roll out of brown bins.

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http://www.wrap.org.uk/local_authorities/research_guidance/food_waste/separate_food_waste.html

This WRAP website contained interesting reports on their food waste collection trials such as:

Evaluation report - food waste collection trials
Case study alternate weekly collections
Case study high density housing areas
Case study low and medium density housing areas
Case study use of liners
Case study multi-occupancy housing
Case study communications

8. Acronyms and Annotation

All acronyms refer to Ireland unless otherwise indicated.

a	year (*L.*) annum
ABP	Animal By-Products
ABPR	Animal By-Products Regulation (European Commission Nº 1774/2002)
AD	Anaerobic Digestion
BMW	Biodegradable Municipal Waste
C	Carbon
℃	Celsius/centigrade
CA	Civic Amenity [recycling centre]
ca.	about, approximately, (*L.*) *circa*
Cd	Cadmium
CO_2	carbon dioxide
Cr	Chromium
CSO	Central Statistics Office
Cu	Copper, (*L.*) *cuprum*
DAFF	Department of Agriculture, Fisheries, and Food
d.m.	dry matter
DoEHLG	Department of the Environment, Heritage and Local Government
e.g.	for example, (*L.*) *exempli gratia*
EC	European Communities
EPA	Environmental Protection Agency
equ	equivalent
et al.	and others, (*L.*) *et alii*
etc.	and so on, in similar respects, *(L.) et cetera*
EU	European Union
EWC	European Waste Catalogue
EWP	European Waste Programme
f.m.	fresh matter
GWC	Green waste compost
h	hour(s)
H_2S	Hydrogen sulphide
Hg	Mercury, (*L*) *hydrargyrum*
HH	Households
i.e.	that is [to say], *(L.) id est*
IPTS	Institute for Prospective Technological Studies
K	Potassium, *(L.) kalium*
km	kilometre
kg	kilo
kg/Inh*a	kilo per inhabitant per annum
m^2	square metre
m^3	cubic metre
Mg	Magnesium
mg/l	milligrams per litre
MS	Member State(s) [of the European Union]
Mt	Mega tonnes [million tonnes]
N	Nitrogen
n.a.	not available
Ni	Nickel
NI	Northern Ireland
NSBW	National Strategy on Biodegradable Waste
NWR	National Waste Report
OC	Organic Carbon
OF	organic fraction
OFBMW	Organic Fraction of Biodegradable Municipal Waste
OM	Organic Matter
PAS	Public Amenity Sites
Pb	Lead, (*L.*) *plumbum*
pH	Quantitative unit of measure of acidity or alkalinity, (*L. pondus Hydrogen*i)
QAO	Quality Assurance Organisation
QAS	Quality Assurance System
QM	Quality Management
R&D	Research and Development
SI /S.I.	Statutory Instrument
STRIVE	Science, Technology, Research and Innovation for the Environment
t	tonne (metric 1,000 kgs) / ton (imperial)
t/a	tonnes per annum
tpa	tonnes per annum
UK	United Kingdom
Zn	Zinc

9. Basic Definitions

ABP / ABPR	Animal By-Products / Regulation. ABP as defined by the Animal By-Products Regulation (EC) no. 1774/2002
Anaerobic digestion (AD)	Fermentation process of organic feedstocks under anaerobic conditions with the objective to produce a methane-rich gas as renewable energy resource, liquid or solid digestion residues (digestate) can be used as organic soil amendment. Solid digestate can be composted together with structure material or other organic feedstocks and used like compost.
Biowaste	Source-segregated biodegradable waste of an organic or putrescible character. It is used in line with the term *'organic waste'* which represents the source separated fraction of municipal waste collected from households and similar premises.
Compost classes	Compost classified according to quality levels. In many cases, the classification refers to heavy metal concentration classes, which are related to specific use restrictions.
Compost types	Composts made from specified categories of source materials
Food waste	For this report we use the term food waste synonym to organic kitchen waste or catering waste from domestic origin and restaurants.
Garden waste (Green waste)	Vegetation waste from private gardens, landscape maintenance including tree cuttings, branches, grass, leaves, prunings, old plants and flowers.
Heavy metals	Even if chemically not fully correct we use heavy metals for the potential toxic elements Cd, Cr, Cu, Hg, Ni, Pb and Zn
Home composting	Composting of organic kitchen and garden residues treated on the property of its origin, the private garden. The compost is recycled to the own garden property.
OFBMW	Organic fraction of biodegradable municipal waste. As defined by the National Strategy for Biodegradable Waste this comprises mainly food and garden waste from the household and commercial sector
QAO (Quality Assurance Organisation)	Organisation carrying out the external independent quality assurance scheme for composting plants. In most of the cases this includes the awarding of a quality label for the certified compost products
QAS (Quality Assurance System)	External independent quality assurance scheme for composting plants. This includes the approval of plant operation (process management) as well as product certification according to existing compost standards.
QM (quality management)	Management required for the entire process of compost production. It starts from the receipt control of delivered feedstock materials and ends with final product storage and dispatch of compost to the customer. QM systems comprise a traceable documentation system to be checked by external QSO or the competent authority if it is part of the licensing and compost related legislation.
Residual waste	This is waste collected from households, commerce, and industry, which has not been separated at source.

10. Appendix 1: Collection Vehicles for Food Waste

Source of photos are from the WRAP Publication “Evaluation of the WRAP Separate Food Waste Collection Trials” June 2009 **ISBN:** 1-84405-416-0

Bespoke design used in Preston

Farid Minimatic on Iveco Chassis

Vehicle used in Mid-Bedfordshire

Food waste collection in Newcastle upon Tyne

Farid Micro used by Elmbridge

Localised bulking in Elmbridge –
from vehicle directly into roll on off skip

Lifting the slave bins in Elmbridge

Food waste collection in Hackney

Food waste collected in Guildford

Food waste collection in Kingston upon Thames

Electric powered vehicle in Shropshire