Waste Collection & Treatment

Document: GACWSR/01 Version: 03

Zero Waste Management Project

Aberdeen City Council

9 January 2012

Halcrow

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Document history

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This document has been issued and amended as follows:

Version	Date	Description	Created by	Verified by	Approved by
01	04/11/11	Draft	Kirsteen Nixon	Martin King	Doug King
02	21/12/11	Final draft	Kirsteen Nixon	Martin King	Doug King
03	09/01/12	Final	Kirsteen Nixon	Kirsteen Nixon	Doug King

Contents

Appendix

1 Waste Collection

1.1 The Zero Waste (Scotland) Regulations 2011

1.1.1 Zero Waste Regulations – Policy Statement October 2011 – Waste Collections

In October 2011 the Scottish Government released a policy statement on the proposed Zero Waste Scotland Regulations in response to a consultation on the draft regulations in early 2011. The policy statement

"sets out the decisions that will underpin the final form of the regulations that will be laid before the Scottish Parliament"

The policy statement sets out various decisions, requirements and deadlines for waste collection as summarised below.

- The food waste collection roll- out period is to be extended. Local authorities will be given a longer period to roll-out food waste collection to households and will have to have initiated the roll-out of a household food waste collection programme by the end of 2013 and to have completed the roll-out by 2015.
- The Regulations will set criteria establishing where local authorities must offer a food waste collection service to householders and businesses. The Regulations will identify areas of the country based on population density and travel distance between towns where local authorities will be required to offer separate collection of food waste from households and businesses. These areas will be based on the Scottish Government urban rural classification.

  - Large urban areas (population over 125,000)

  - Other urban areas (population of 10,000 to 125,000); and

  - Accessible small towns (with a population of 3,000 to 10,000) and within 30 minutes' drive of a settlement of 10,000 or more)
- The Regulations will introduce measures to ensure the quality of materials collected and processed.
- The Regulations will stipulate that co-mingling of dry recyclables will only be permitted where the hierarchy is not undermined (e.g. glass separated for re-melt) and the outputs from the MRF are comparable quality to that collected separately at kerbside.
- There will be a requirement on local authorities to offer separate collection of glass, metals, plastics, paper and card to householders by 2013. In the same way as the current duties on local authorities to offer black bag waste collection services to householders and businesses, this new duty will also apply to householders and businesses.
- Provisions will be made in the Regulations to enable Ministers to issue quality standards (or codes of practice) for recycling. This will allow statutory based standards to be introduced if required.

- The decision on whether to collect textiles will be at the discretion of the local authorities.
- There will be a requirement in the Regulations for small businesses to provide source segregation of food waste by 2015.
- Local authorities will be allowed to co-mingle food and garden waste where similar environmental benefits to separate food waste collection can be demonstrated and achieved.
- In situations of high density housing (e.g. high rises greater than four floors) the statutory requirement to collect food waste will be limited to households than can present a bin at kerbside. However, providing food waste collection to areas of high density housing will be important to contribute to achieving Zero Waste Plan targets.
- Available evidence indicates that separate weekly collection of food waste typically delivers the highest yields, the best environmental outcomes and is likely to be less expensive than systems collecting food and garden waste together on the same frequency – mainly down to the fact that when food waste is collected and managed separately it allows garden waste to be treated using lower cost methods such as windrow composting. It is likely that as the costs of residual waste management increase over time, the benefits of separate food waste collections will also increase. The Scottish Government's preference is therefore for separate collection of food waste from households, businesses and other premises e.g. schools, hospitals. Wherever possible food waste collected separately should be treated in PAS compliant AD facilities.
- In some circumstances where there is access to dry Anaerobic Digestion (AD) facilities, where there is existing In-vessel Composting (IVC) infrastructure and/or where a weekly garden waste collection service is available a co-mingled bio waste collection may provide a similar environmental outcome to separate foods waste collection.
- For these reasons co-mingled garden and food waste collection services will be permitted where they can be demonstrated to deliver equivalent or better environmental outcomes as determined by similar yields of food waste.
- The Scottish Government does not intend to create enforcement arrangements to police decisions by individual Councils.
- The Scottish Government's Zero Waste Plan (2010) sets a 70% recycling rate target for household and all other waste streams by 2025.
- Statutory actions of the Regulations will include source segregation and separate collection of the key material recyclable materials; key recycling materials are paper, card, glass, metals and plastics. Food waste is also targeted due the environmental benefits of managing bio wastes separately. Different regulatory requirements for separate collection apply to collection services to householders by local authorities.
- Once recyclable materials have been segregated they must be managed in a way which does not compromise their quality. SEPA will be responsible for ensuring segregated materials are not mixed with other wastes.

- There will be a ban on landfilling the key recyclable materials. This supports the upstream source segregation and separate collection measures taken to maximise levels of quality recycling by banning those materials from landfill when they are source segregated and separately collected.

Timescales

Timescales for introducing the measures to be set out in the Regulations are:

- 31 December 2013

Source segregation

Businesses (all businesses) to present dry recyclables and food waste (medium to large businesses involved in food production, food retail or food preparation) for collection.

Local authorities must offer dry recyclables collection service and begin roll out of Food Waste.

Bans

Ban on mixing source segregated materials

Ban on landfilling and incinerating source segregated materials.

- 31 December 2015

Source segregation

Businesses to present food waste (small businesses involved in food waste production, food retail or food preparation) for collection.

Local authorities complete roll out of food waste collection.

Bans

There is a requirement to remove dense plastics and metals from residual waste prior to incineration for existing facilities. For new facilities this will apply at the commencement of the Regulations.

- 31 December 2020

Bans

Ban on biodegradable material to landfill.

Summary of New Waste Policy as it will impact on Municipal Waste Collections.

- The Regulations will impose a ban on separately collected recyclables and food waste going to landfill. This will be a universal ban irrespective of the source of the waste. It does not mean that they must be removed from mixed/unsorted waste prior to disposal in landfill.
- In addition there will be a mandatory requirement to provide source segregation.
- There is to be a ban on separately collected materials going to incineration by 2013. This ban includes mixing these materials.

- Rejected material from MRFs can be disposed of by incineration.
- There will be a requirement that best available techniques to be used to remove marketable recyclate from residual Municipal Waste (MW) prior to incineration. This will focus on dense plastics and metals initially and can be a simple MRF. Removal of these marketable recyclable materials can either be carried out immediately before incineration or off-site. This will be introduced at existing facilities by 2015.

On 10th October 2011 Zero Waste Scotland launched a project to identify good practice for kerbside collections for local authorities.

The results will support new regulations from the Scottish Government which will guarantee minimum level of recycling provision from most homes and businesses in Scotland.

The scope of the project extends to kerbside recycling, residual waste and food waste collections, and will identify best practice for each and it will also examine elements such as customer service and value for money.

1.2 Aberdeen City Council's Current Waste Collection Service

The current waste services offered by ACC are summarised in the table below:

Waste Services	Properties served by each service broken down to collection routes	Container collection types including daily tonnage collected from each route and each property type if possible	Vehicle Resource	Vehicle Crew Size
Fortnightly dry recyclate kerbside collection (Split body collection vehicle)	76,338	Box - 55 litres Bag - 35 litres	15 Refuse Collection Vehicles (RCVS) 2 RCVs collecting domestic paper	1 driver + 1 loader 1 driver + 1 loader
Fortnightly Food and Garden waste kerbside collection (RCVs)	54,021	Bin - 240 litre (140's available) Caddie - 7 litre (kitchen use)	8 RCVs	1 driver + 2 loaders
Fortnightly Residual waste collection (RCVs)	800 - rural weekly 76,000 - normal residual fortnightly 330 - Communal fortnightly	240 litres 240 litres 1280 litres	20 RCVs	1 driver + 2 loaders
On-street paper recycling	93 units - 1280 litres	1280 litres	Assumed collected by one of the RCVs listed in the table	1 driver + 1 loader
Household Waste Recycling Centres	Currently four centres (one new site to be added, Grove Nursery, Hazelhead Avenue) 1 East Tullos, 2 Perwinnes Moss, 3 Sclattie, 4 Pitmedden Road			
Recycling points	106 – private and public points.	Majority 1280 litres, also 4 Nodes ('mini-recycling' centres)	6 collection vehicles of various types	1 driver + 1 loader
Bulky Collections	Domestic Chargeable		4 RCVs	1 driver + 1.5 loaders
Commercial Glass Collections			1 RCV	1 driver +1 loader
Commercial Paper Collections			1 RCV	1 driver +1 loader

1.3 General Discussion on Municipal Waste Collections

Local authorities in Scotland have made great strides in recent years in starting a transition from the historic reliance on landfill disposal towards systems which focus on recovering materials for re-use.

These achievements have required changes in the ways our refuse has been collected across the public sector and the impact on domestic collections has drawn public comment.

A significant number of the Councils have changed their collection systems so that the collection of material for recycling and/or composting alternate on a weekly basis with residual waste for treatment and disposal. These systems, which are diverse in their detailed design, have become known collectively as Alternate Weekly Collections (AWC).

Aberdeen City Council has adopted this method of collection for Residual Waste, Food and Garden Waste and Kerbside collections of recyclable materials. A review is currently being undertaken to determine what methods of municipal waste collections are right for the Council to ensure they are effective and gain and retain the support of local people.

AWC has become a generic term to describe a diverse range of municipal waste collection scheme designs, but the basic concept is that the reduced collection frequency for residual waste is an incentive for householders to separate recyclable material into the recycling collections. The lower cost of the residual waste collection service frees resources to fund investment in recycling services.

There is no single definition of an AWC scheme, however, the variants in use have the common features that residents are still provided with a weekly collection service, but they are asked to separate their recyclable materials and in some cases compostable waste from the residual fraction and the different fractions are collected on different frequencies. Generally, the residual waste is collected one week and the recyclable fraction is collected the next. Some AWC schemes, however, operate with weekly collections of food waste and / or dry recyclables.

AWC is designed to encourage participation in recycling and composting by restraining the extent to which recyclable waste can be put into residual waste bins and at the same time releasing resources of money, manpower and equipment to provide high quality recycling services. This approach should not lead to a reduction in the total collection capacity provided to individual households.

Appropriately specified and well run AWC schemes can help deliver changes in behaviour and involve consultation and implementation actions. These include

- Raise awareness of the volumes of waste generated, prompting the segregation of materials for recycling and composting; and
- Prompt an overall reduction in waste arising at the kerbside. The reduction is likely to be brought about by residents changing their habits regarding the amount of material they manage via other means (e.g. home composting) or by changing shopping habits to reduce e.g. food and packaging waste.

It is clear that well designed and executed collection schemes should contain certain key features:

- There should be consultation with both elected members and residents when considering service changes.
- Once changes have been decided on, there should be continuing communication of the service changes across the different phases of planning and implementation including regular feedback to all.
- AWC must be accompanied by a high quality recycling service.
- Schemes should be designed for ease of use by residents and services should be reliable.
- Residents should be provided with sufficient container capacity for their recyclables – they must be able to recycle at least half of their waste materials to compensate for the reduction in residual waste capacity.
- Particular consideration should be given to bulky items like plastic bottles.
- Schemes should have some flexibility to deal with special circumstances.
- New schemes will initially be confusing for some residents and additional resources must be made available to provide residents, who require it, with additional support to help them adapt to the new services.
- Designing systems that are similar to successful schemes in neighbouring authorities will help to reduce confusion.
- Although there are powers of enforcement available to local authorities, successful schemes should rely first on public understanding and acceptance of the arrangements and reserve formal enforcement to the last resort.
- The design of the scheme should address known public concerns. So, storage of refuse should be in secure, rigid containers to respond to concerns about the increased risk of odour, flies and other nuisances as a result of storing waste for up to two weeks. Householders will need simple practical advice on wrapping and bagging waste to reduce these risks.
- Much of the public debate about municipal waste collection systems particularly in relation to AWC has focused on public concerns about storing food waste.

What Do Your Elected Members Want?

Any change to refuse collection services is likely to be controversial. Municipal waste collection services are delivered routinely and are therefore often taken for granted until changes are introduced or something goes wrong.

It is the role of elected members to reflect the views of local people about service provision, standards and costs and to make decisions.

Gaining the support of all elected members is essential and something which strenuous efforts should be made to achieve.

Elected members can be a real asset to a waste collection project team; helping to disseminate information, dealing with enquiries and concerns and communicating a positive message regarding the introduction of improved schemes to the local community.

Equally, it will be important to respond to concerns raised by members and to be flexible to individuals' requirements.

It can be useful to invite elected members to briefing sessions about development of waste collection and treatment plans. This provides the opportunity to issue members with information packs highlighting the reasons for developing proposals and responses to some of the more frequently asked questions. Meetings with elected members from other authorities can also be useful.

Below are some examples of how councils can successfully engage with elected members:

- Elected members are asked to try the scheme out for themselves so they could determine whether it would be possible for residents to manage with a new collection system, for example. This allows them to provide informed responses to queries from residents and to become champions for the scheme; and
- Elected members along with all staff (including operational staff) attended a set of workshops on what changes were being proposed and why, so that they could act as ambassadors and answer basic questions from the public.

What Do Your Residents Want?

In order to assist elected members to perform their role effectively they require information about the expectations and preferences of residents. Therefore an awareness of what residents want from their waste and recycling service should be ascertained. If this is not currently available consideration should be given to undertaking a general consultation exercise, perhaps linked to wider issues relating to the waste management strategy to provide context.

Alternatively it would be worth exploring the potential to draw on the activities of existing local consultative networks, such as Local Strategic Partnerships, Community Councils, Community Groups and Residents' Associations to supplement information regarding public opinion.

Choosing the Correct Recycling System

There is no simple answer, and certainly no 'one-size-fits-all' solution. Local authorities have to make choices that are right for their local circumstances. Provision for recycling needs to be considered alongside requirements for refuse, garden and increasingly food waste and taking account of factors such as the physical characteristics of collection areas and property types.

Refuse (Residual Waste) Collections

Residual waste in Aberdeen City is currently collected via 240 litre wheeled bins and 1280 bulk bins. For many Councils, 240litre wheeled bins have been the standard means of waste containment for a number of years. In some authorities 240 litre

wheeled bins are not standard as they choose to provide a smaller capacity bin to help further encourage waste minimisation and recycling.

Bulk bins are normally used to provide residual waste collection services to multiple occupied properties of which Aberdeen City has a significant number. Bulk bin collection is usually demand led and collection services to this type of property configuration are difficult to police. This results in the Council service being driven by the need to have the waste removed at higher frequencies in order to maintain reasonable environmental standards.

Dry Recyclable Collections

The provision of recyclable material collection services is a completely different concept from the service provided for residual waste collection. In the case of residual waste the emphasis is on a collection system design based mainly on environmental grounds with the emphasis on speedy removal of the waste to disposal or treatment. In the case of recyclable material the collection system design is mainly to effect high participation rates, maximising recovered tonnage and delivering a high quality of recovered materials.

For schemes to be effective, it is essential that a comprehensive service is provided for recyclable materials and that sufficient capacity is provided for the householder to store the materials prior to collection. Many residents are confused by complicated rules applied to some schemes and by the degree of variation between schemes in neighbouring authorities. Recycling schemes should be as simple as possible for the users and clearly communicated to them.

Local authorities employ various systems and combinations of systems for the collection of recyclable material from domestic and commercial properties. These systems however are variations of two main methods of collection namely kerbside sort and co-mingled.

AWC works effectively with both kerbside sort and co-mingled collections of dry recyclables.

Some of the key issues to be considered when deciding which type of collection system to adopt in a local authority area for recyclable materials are:

- The property types from which the material has to be collected.
- The property mix within a local authority area;
- The range of recyclable materials collected. Particular consideration ought to be given to bulky materials such as plastic bottles and cardboard;
- The capacity provided to householders to store their recyclables prior to collection, be that in bags, boxes or bins;
- Reliability and quality of the collection services;
- The quality of the recyclable materials being recovered;
- Maximising the tonnage of segregated recyclable materials recovered from the household waste stream and the participation levels achieved;
- Impact on recycling schemes; and

- Equality and flexibility of service provision.

Experience has shown that AWC schemes result in an increase in both participation in recycling and set out of recycling containers. (One example of this is at Daventry District Council who provided a weekly refuse service alongside a weekly kerbside sort collection for dry-recyclables and experienced a 45% increase on the yields of recyclables collected when they changed to a fortnightly refuse collection scheme).

Kerbside Recyclable Material Collection Systems

- Kerbside sort – involves the sorting of materials at kerbside into different compartments of a specialist collection vehicle.
- Co-mingled collection schemes involve the kerbside collection of a range of recyclable materials in one container, usually a wheeled bin. This system tends to deliver a higher tonnage of materials but of a lesser quality and requires sorting at a Materials Recycling Facility (MRF)

There are variations to these two main methods of collecting recyclable materials however in this paper we are simply considering them generically.

The property mix within Aberdeen City comprises significant numbers of detached, semi-detached, terraced and flatted properties thus posing the question:

What system should be adopted for the collection of dry recyclable materials?

Kerbside Sort Collections

This collection system is best suited to detached, semi-detached and terraced houses, on the basis that space for the required container types and access for collection vehicles and operatives is generally not an issue. In these types of properties the occupier can present their containers at the kerbside for collection.

Kerbside sort systems however are less efficient for the collection of recyclable materials from flatted properties particularly if the material is collected from each doorstep or landing. If a communal kerbside sort system of collection is provided to flatted properties it can prove costly, inefficient and difficult to accommodate the storage capacity required for the number and capacity of the communal containers required.

Access for collection vehicles and operatives can also be problematic when servicing flatted properties particularly if a kerbside sort system is introduced.

Kerbside collection schemes may be suitable for some smaller blocks of flats, such as converted houses however it is not efficient or cost effective to introduce different collection systems for every variation in property type.

For these reasons local authorities mainly provide communal co-mingled collections of recyclable materials to flatted properties.

With kerbside sort systems, most materials are kept in separate streams on the vehicle and not compacted although some material streams can be collected mixed, e.g. glass, cans and plastic bottles. This reduces the sorting time and increases the effective use of space on the vehicle while not compromising the quality of the collected material.

The main advantage of sorting the material at the kerbside is that contamination of materials that cannot be recycled is identified and left in the container. If the reasons for this rejection are explained to residents there should be an improvement in the understanding of the service resulting in its correct use. More importantly, kerbside sorting ensures a high quality material for market with typical contamination levels of less than 0.5%.

Co-mingled Collection Systems

Co-mingled systems involve the presentation of recyclable materials in a single container, normally a wheeled bin, in which all the recyclable materials are mixed together. Collection is normally from the kerbside in a single compartment vehicle. Sometimes however they are collected in the compartment of a split body vehicle at the same time as the residual waste. This form of collection can be flexible on round design and can collect from more properties per round as they are not as constrained by compartment capacities for individual materials and the co-mingled materials are compacted. The most commonly used vehicles are standard Refuse Collection Vehicles (RCVs) such as those currently employed by Aberdeen City Council. Good practice for co-mingled collections indicates that materials should not be over compacted during collection as this can impact on material quality and the efficiency of the Materials Recycling Facility (MRF).

Another form of co-mingled collections is a survival bag system. This system requires the householder to place the required recyclable materials in a survival bag provided by the Council and placed in the same container as the residual waste. The survival bags are ultimately retrieved at a transfer station before being opened and the materials sorted at a MRF.

Advantages of using RCVs for co-mingled collections include their flexibility, their ease of hire in the event of breakdown or unscheduled maintenance and their quick off-loading times. Kerbside co-mingled systems can be combined with collections from multi-occupancy dwellings using communal bins, thus enabling the same system to be used across the whole authority area.

One consideration of this type of collection system is whether to include glass separately from other recyclable materials. If glass is collected in a co-mingled form with other recyclable materials special segregation facilities need to be provided at the MRF to retrieve the glass and segregate the various glass colours. For these reasons glass in normally collected separately.

The impact of contamination rates including the collection of non-targeted materials depends mainly on the efficiency of the monitoring of quality by the collection crews and the management of the materials as they are received and sorted at the MRF.

Two stream partially co-mingled collections provide a viable compromise between kerbside sort and co-mingled systems addressing some of the primary concerns of co-mingled collections and kerbside sort operations, such as round size and retaining high material quality. These systems tend to collect a range of materials typically paper and card, glass, plastic bottles and mixed cans, and maintain material quality by keeping the two streams - fibres and containers - separate. Contamination in two stream collections is considered to be around 5%.

Other vehicles available e.g. split body RCVs or 'pod' vehicles are designed for different service profiles and not just for the collection of recyclables e.g. the co-collection of recyclables with other waste streams such as refuse or garden waste. An example of how this could work for ACC is to set-up an alternate refuse and recycling collection with a weekly food waste collection whereby food waste is collected in a 'pod' and refuse and recycling is collected in the much larger part of the vehicle body.

Split Body RCV - these are conventional RCVs with a split body i.e. the whole body is split vertically from the rear. The split varies depending on the materials targeted, usually a 50/50 split with fibres on one side and containers on the other. A 70/30 split can be used where fibres and only two container streams are collected.

Organic Waste Collections

Aberdeen City Council has recently carried out a review of its organic waste collection service with particular emphasis on food waste. The results of the resultant Outline Business Case (OBC) are currently being finalised.

When targeted through a dedicated service, as is the case in Aberdeen City, organic waste (co-mingled garden and food waste) is collected on an AWC basis. Seasonal fluctuations in garden waste can raise issues when seeking to integrate garden waste collections with other services.

Aberdeen City Council currently collects food waste with garden waste in a co-mingled form. There is evidence that suggests where this happens, the tonnage of food captured for recycling is generally lower as residents dispose of their food in both the organics and residual bins (tending to use whichever is due to be emptied next). However the increase in tonnage delivered by single stream collections is likely to be small and therefore difficult to justify in cost terms.

However, when deciding what type of organic waste collection service is provided consideration must be given to the cost of providing a segregated service and the tonnage and environmental benefits likely to be achieved.

Consideration may be given to combining collections with other schemes, for example weekly food waste collection alongside the alternate weekly collection of residual waste and recyclables via the use of split body/pod vehicles. As the volume of garden waste to be collected will vary significantly seasonally it may be more practical to collect garden waste separately. Such considerations must take account of the daily tonnages of each waste stream being collected and any significant seasonal variations.

Quality

Quality is assessed by the ability to consistently deliver materials to the market place that are:

- effectively separated to meet re-processor and end market requirements;
- in the required volumes and with security of supply; and
- at a price that sustains the market

It is well known that the UK exports a percentage of its collected recyclable materials. It is less well known that in key areas e.g. paper, aluminium and certain types of glass, UK re-processors are importing materials because sufficient material of the required quality is not available on the UK market. However, we know that some material, which would not be of sufficient quality for UK re-processors, finds export markets in countries where low labour costs allow further sorting before the material can be reprocessed. Where this is managed badly, media coverage of the activity has posed a significant threat to the positive perception of recycling among the public and is one of the identified barriers to recycling.

Well managed kerbside sort systems which allow contamination to be filtered out at the point of collection gives the most reliable stream of quality materials at the point of collection. The ultimate quality of the material sent to reprocessors is also dependent on the efficiency of any interim management of material at bulking facilities or MRFs.

Co-mingled collections can face quality problems from three sources:

- householders putting the 'wrong' materials into the collection,
- compaction of the waste which breaks glass into small pieces and tends to bind materials together, and
- technical and physical capacity of the MRF to separate materials in the volumes delivered to them.

Refuse Collection Vehicles

There are numerous vehicle manufacturers' designs, types, sizes and configurations available as detailed above and include:

- Rear End Loading (REL) compaction vehicles (available in a variety of sizes);
- 2 or 3 compartment variations to the standard REL;
- Compartmentalised top loading vehicles;
- Various designs of stillage vehicles, suitable for kerbside sorting of dry recyclables (often purpose built to suit particular waste collection configurations); and
- Various kerbside vehicles, which enable sorting of dry recyclables into troughs then top loading them into compartments.

It is important that the benefits and limitations of the different vehicle options are considered fully when developing collection schemes. Inappropriate vehicle specification can have a significant impact on efficiency and cost. It is therefore critical to effectively match the capacity of the vehicle to the materials to be collected.

As a general rule, the more flexibility the vehicle has regarding the use of space then the greater likelihood of an efficient operation.

Before committing to the purchase of any vehicle type it is best ask the manufacturer to provide a vehicle to trial its effectiveness for the purpose it is to be used for.

Waste Containers

There is no one ideal combination of containers as each is more suited to certain areas and tasks. The priority is to successfully manage capacity: limiting capacity for the activity that you want to discourage, enhancing capacity for the activities that you want to encourage.

Predominantly there are three types of containers in common use: wheeled bins, boxes/crates and sacks. Each is available in a variety of sizes.

Wheeled bins are the most common containers used for residual waste collection and the most common size in use is 240 litres. It is generally accepted that the introduction of 240 litre bins on weekly collection services has led to increased quantities of waste being collected, which has led some councils introducing wheeled bins for the first time to opt for 140 or 180 litre containers. It is also accepted that collection rounds take longer with wheeled bins when compared to disposable sack collections. Wheeled bins offer the benefit of containing waste, which reduces the risk of litter and animal damage. As the operational life of a wheeled bin is at least 10 years it limits flexibility when other collection profiles are being considered at a later date. Wheeled bins are normally a better manual handling option than other containers in that they do not usually need to be lifted.

It would be a mistake however to assume the choice of container(s) in itself makes for a safe operation. Whichever container is used there is a need to establish and enforce safe systems of work. It is essential to revisit risk assessments (or carry out new assessments) to reflect any changes that are to be introduced. The assessments will need to take account of any proposed changes to containers, vehicles, range of services, collection frequencies, set-out rates, weights in containers, rounds and interaction with the public. In addition, it is important to consider the effective involvement of staff and the public in managing and implementing any changes.

Wheeled bins are not trouble free, however, as uneven terrain, steps, kerbs and slopes frequently have to be negotiated. This can lead to slips, trips and sprains which are amongst the most commonly occurring injuries in collection activities. There are also risks associated with bins falling off bin lifts, either because they have not been presented properly or, more commonly, due to the bins being damaged. Being struck by falling objects is another common cause of injury within the industry.

Boxes/crates are regularly used for dry recycling collections. This type of container is necessary for kerbside sorting operations which, in turn, allow contaminants / non-recyclable materials to be rejected and left at the kerbside. Boxes generally have to be lifted and carried to the collection vehicle and it is therefore important that safe systems of work are identified and implemented. The size, design and number of boxes to be used needs to be considered particularly if the Council will be required by law in the future to collect single stream waste fractions resulting in the provision of individual containers for each waste type. This would involve additional manual movements although the weights should be lighter as the waste fractions would be single stream only, however as stated above any collection method change will be subject to a risk assessment

The chosen solution must balance adequate capacity for householders with safe working practices (regarding lifting and minimising strain). This may include considering different containers for heavier materials such as paper and glass and

discouraging the carrying of multiple containers (which could also impair vision). It is also important to ensure that the design of the vehicle is suitable to allow ergonomically acceptable loading to take place.

Sacks, once the standard container for residual waste, are less common today as many authorities have introduced waste containers to help improve street cleanliness, ease of collection and prevention of vermin. Sacks are not generally suitable for AWC of residual waste which includes food. Where, for practical reasons, residual waste needs to be presented for collection in sacks, because wheeled bin collections are not possible, provision needs to be made for the sacks to be contained securely between collections. Disposable sacks are used by some authorities for collecting co-mingled dry recyclables.

One-trip paper sacks are used by others for garden waste whilst re-usable sacks of various shapes and sizes are in use for particular material streams - most commonly paper and garden waste. Sacks are generally considered to present a number of occupational health and safety issues including manual handling problems from lifting and carrying (including multiple carrying), potential for injury from sharps, and muscular-skeletal injuries from throwing the sacks onto the vehicle.

Survival bags can be used for the collection of specific waste streams. As stated previously this method of collection normally involves the householder placing specific waste fraction(s) such as textiles or dry recyclable materials in a survival bag provided by the Council and placed in the container provided for residual waste. The survival bag is then collected with the residual waste and taken to a transfer station/MRF where it is retrieved, and its contents recycled.

Health and Safety

Where appropriate specific health and safety issues have been included above for each container type however whichever system local authorities choose they have a duty to ensure that it is operated safely. The collection of materials for recycling is a physically demanding activity carried out in a hazardous environment. In respect of the principle categories of accidents reported – slips, trips and falls and moving vehicle injuries – the exposure to risk is likely to be similar for all systems. There are some risk categories where there are differences between the systems but no system is believed to carry risks which cannot be practically managed.

In 2006 an ergonomic study by Health and Safety Laboratory (HSL/2006/25) concluded that the likelihood of muscular skeletal disorders could be greater for box and sack based systems and recommended the use of wheeled bins. A later report from the Centre for Health and Environment Research and Expertise (A Health and Safety Study of Recycling Schemes Using Boxes and Bags) concluded that there were no significant risks in kerbside sort systems that could not be managed or controlled. For co-mingled collections there are the safety implications of sorting materials at MRFs to take into account when making decisions. In making decisions authorities can consult the latest HSE/WISH guidance; Safe Waste and Recycling Collection Services and may also wish to use the Wrap Risk Comparator Tool. (Wrap Report on Choosing the Right Collection System)

It would be a mistake to assume that the choice of container(s) in itself makes for a safe operation. Whichever containers are used it is necessary to establish and enforce safe systems of work. A risk assessment should be carried out on the method of collection adopted. These assessments will need to take account of any proposed

changes to containers, vehicles, and range of services, collection frequencies, and set-out rates, weights in containers, rounds and interaction with the public.

Costs

When modelling the operational costs of current and potential future services, the following must be considered:

- Financing cost and replacement frequency for containers;
- Vehicle costs such as financing / leasing, fuel, maintenance and depreciation;
- Staff wages and supervision costs;
- Material revenues and recycling credits;
- Disposal costs (gate fees / landfill tax);
- Monitoring of fly-tipping;
- On-going communications and publicity.
- Container purchase (these can be either a one off payment or financed, in which case the finance becomes an operational cost);
- Communications costs (leaflets, road-shows etc.)

2 Waste Treatment

2.1 The Zero Waste (Scotland) Regulations 2011

2.1.1 Zero Waste Regulations – Policy Statement October 2011 – Waste Treatment

In October 2011 the Scottish Government released a policy statement on the proposed Zero Waste (Scotland) Regulations (the Regulations) in response to a consultation on the draft regulations in early 2011. The policy statement

"sets out the decisions that will underpin the final form of the regulations that will be laid before the Scottish Parliament"

The policy statement sets out various decisions, requirements and deadlines for waste treatment as summarised below

The Zero Waste Plan and Regulations intend to

- Maximise the amounts of waste available for recycling;
- Minimise the need for residual waste treatment capacity; and
- Ensure only those materials that can't be recycled require some form of residual treatment/management.

This will be enforced by:

- Introducing a ban on separately collected recyclables and Food Waste going to landfill. This will be a universal ban irrespective of the source of the waste. It does not mean that they must be removed from mixed/unsorted waste prior to disposal in landfill.
- Introducing a mandatory requirement to provide source segregation.
- The ban on biodegradable waste going to landfill, to be imposed from 2020, will drive residual waste into some sort of pre-treatment.
- The ban on separately collected materials going to incineration by 2013. This ban includes mixing these materials.
- Allowing rejected material from MRFs going to incineration.
- Introducing a requirement that best available techniques to be used to remove marketable recyclate from residual MW prior to treatment or disposal. This will focus on dense plastics and metals initially and can be a simple MRF. Removal of these marketable recyclable materials can either be carried out immediately before incineration or off-site. This will be introduced at existing facilities by 2015.

The Regulations will stipulate that co-mingling of dry recyclables will only be permitted where the hierarchy is not undermined (e.g. glass separated for re-melt) and the outputs from the MRF are comparable quality to that collected separately at kerbside.

Provisions will be made in the Regulations to enable Ministers to issue quality standards (or codes of practice) for recycling. This will allow statutory based standards to be introduced if required.

To ensure materials which could have been reused or recycled are not unnecessarily treated or sent to landfill, residual waste must be pre-treated to remove key recyclable materials, providing a second opportunity to capture recyclate missed at the source segregation stage.

Unsorted municipal waste will need to be pre-treated to:

- Remove recyclable materials
- Create waste stream that can be used to recover energy e.g. RDF
- Produce a stabilised fraction for landfill

When enacted the Regulations will revoke most of the requirements set out in the Landfill Allowance Scheme (Scotland) Regulations 2005.

2.2 Waste Treatment Technology Types

The following sections give a general overview of waste technologies available for the treatment of municipal waste streams. Each of the technology types have been assessed against a given criteria listed below.

- whether the technology is proven, has a significant commercial operating history of an appropriate scale, significant track record of operation and of treating similar waste streams commercially;
- impact of the animal-by-products legislation;
- process type
- input type(s) being processed;
- markets for outputs produced
- typical plant footprint;
- potential regulatory, planning and environmental issues;
- consideration of the ability of the technology to qualify for Renewable Obligation Certificates (ROCs) and other revenue support schemes such as Feed-in-tariffs and Renewable Heat Incentives, the potential to export power, the ability to deliver Combined Heat and Power (CHP) systems and meet the efficiency standards required by European Directives and SEPA. The regeneration or major new development schemes identified in WP1 will be referred to, however their ability to utilise power or CHP will require further assessment, which is out with the scope of this project. This will require further scoping and pricing.

The results of these assessments are contained within Appendix A.

2.2.1 Anaerobic Digestion (AD)

Anaerobic digestion (AD) is a managed biological process in which biodegradable waste is broken down by naturally occurring micro-organisms in the absence of oxygen to produce a stabilised residue. AD can reduce the volume of waste by approximately 60%.

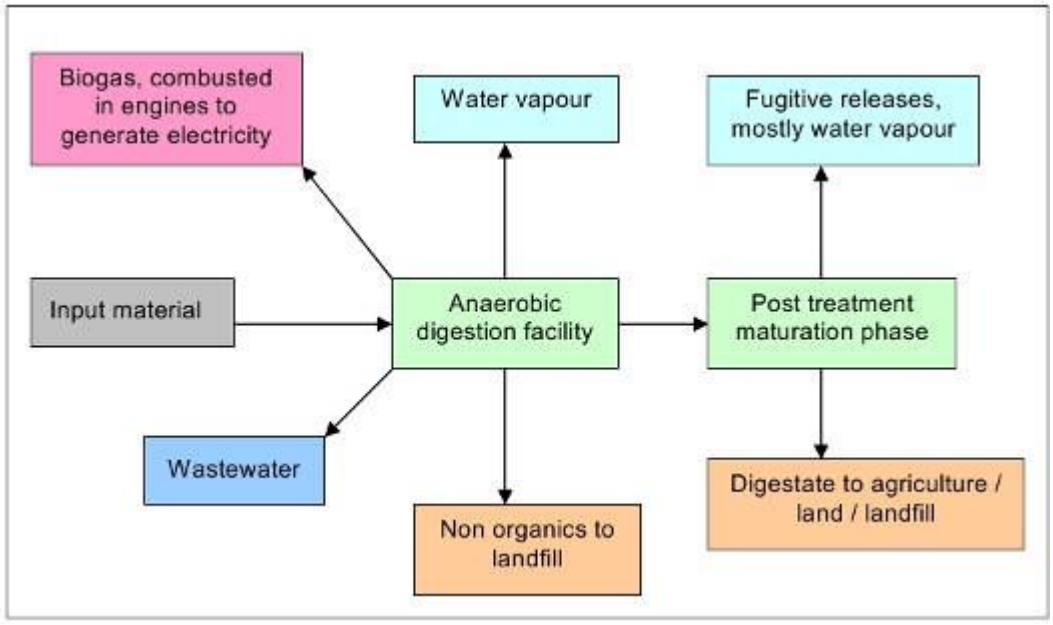
AD plants are most efficient when treating biodegradable waste feedstock in enclosed vessels in the absence of air to produce a digestate, composed of bio solids and liquid, and a methane rich biogas.

It is claimed by certain technology providers that this technology can also treat residual municipal waste but less efficiently than a purely biodegradable feedstock. When used to treat mixed waste there will be a greater tonnage of residue to be disposed of by further treatment or landfill and less electricity per tonne generated. The digestate resulting from the AD treatment of residual municipal waste will contain a high level of contamination which limits its after use.

AD plants have a long track record in the successful treatment of sewage sludge and the degradation of organic waste products to produce methane gas allowing the generation of electricity (whose sale is eligible for ROCs –renewable obligations certificates which offer a financial incentive to produce energy from renewable sources) and/or heat, AD therefore recovers energy. AD plants generally need to be located near to the source of waste with good transport links to minimise costs. Such facilities are often at the scale of 50,000 tonnes per annum (tpa).

AD may be combined with a range of other waste treatment technologies. It can be used after waste has been treated at an MRF separation facility, and in conjunction with waste treatment technologies for the non-organic fraction of waste.

Figure 2.2.1 - Schematic of AD facility process



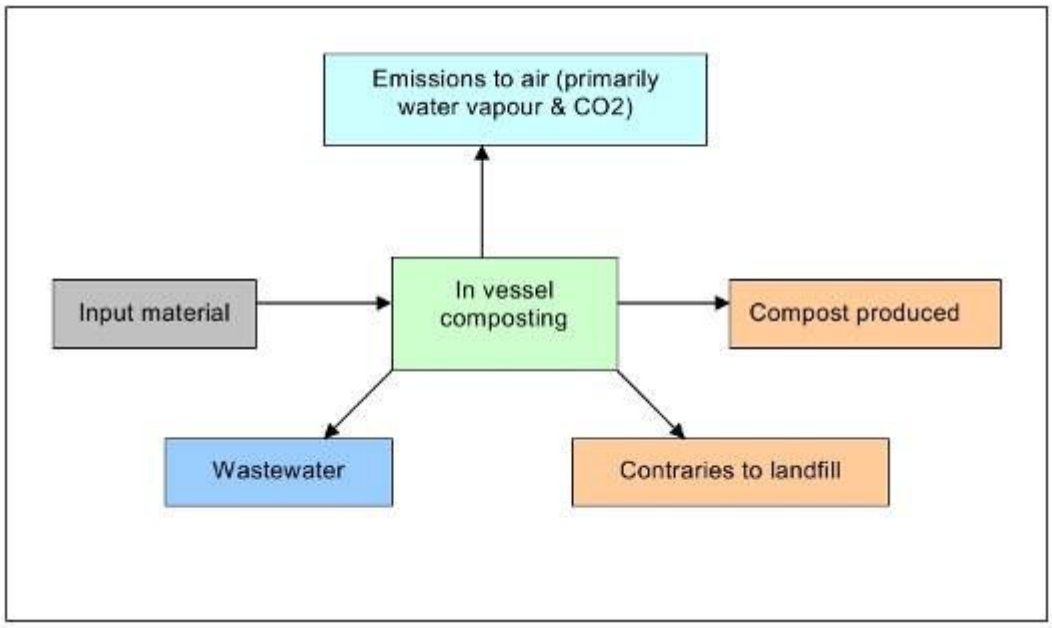
2.2.2 In vessel composting (IVC)

In-vessel composting can be used to treat food and garden waste mixtures. These systems ensure that composting takes place in an enclosed environment, with accurate temperature control, monitoring and recording.

There are many different proprietary systems, but they can be broadly categorised into six types: containers, silos, agitated bays, tunnels, rotating drums and enclosed halls.

This technology is basically a natural biological composting process but is carried out in a controlled, enclosed environment.

Figure 2.2.2 - Schematic of IVC facility process



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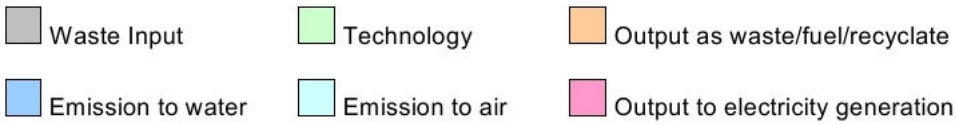
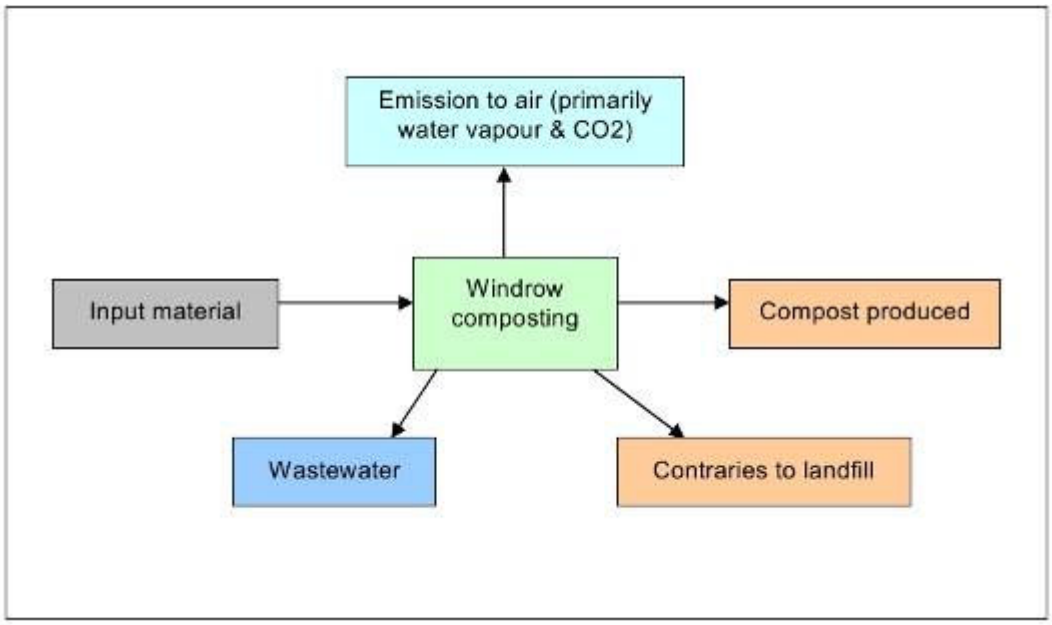


2.2.3 Open Windrow Composting

Windrow composting is used for processing garden waste, such as grass cuttings, pruning and leaves in either an open air environment or within large covered areas where the material can break down in the presence of oxygen.

Windrow composting cannot be used to process organic materials which include catering and animal wastes as these have to be processed via in-vessel composting (IVC) or anaerobic digestion (AD) due to their Animal By-Products Regulations (ABPR) categorisation.

Figure 2.2.3 - Schematic of Windrow Composting facility process



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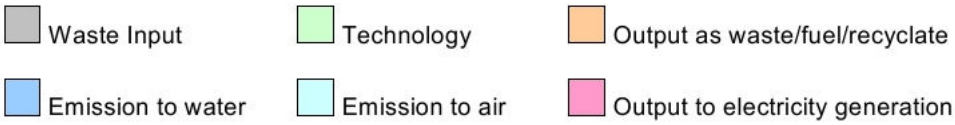


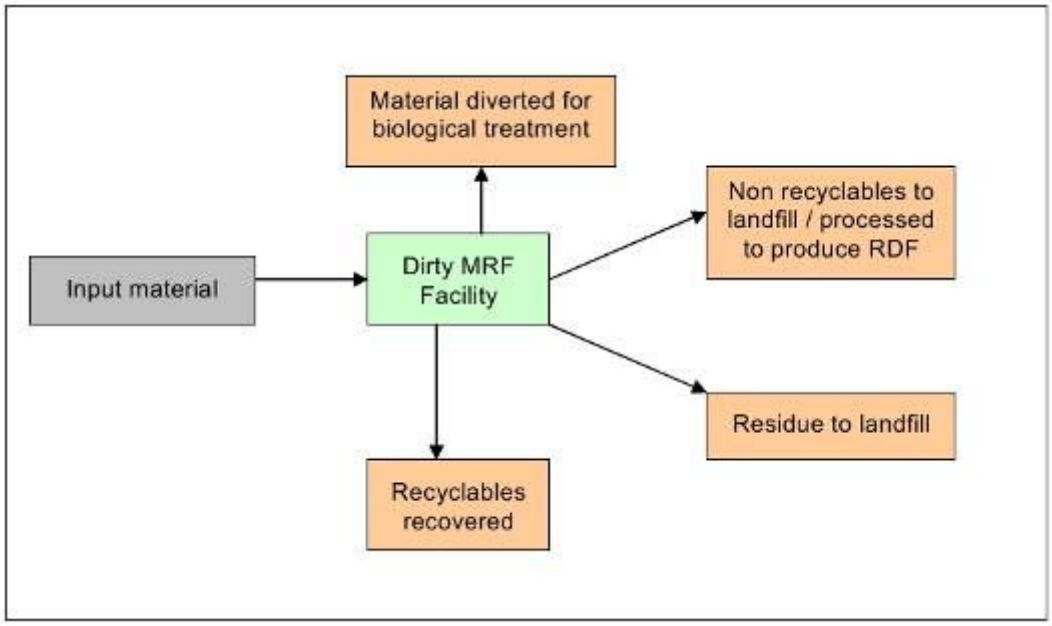
2.2.4 Dirty Materials Recycling Facility (Dirty MRF)

Dirty Materials Recycling Facility is a treatment that separates residual municipal waste into recyclable and non-recyclable materials. The waste is passed through a system of conveyor belts, screening, handpicking and other sorting techniques. Metals, mixed plastics, paper, glass and textiles are the typical materials recovered through this process.

One of the main disadvantages of Dirty MRF technologies is the low quality and quantity of recyclable materials recovered and low tonnage of waste diverted from landfill. A dirty MRF will typically recover around 10-20% of recyclable material and the remainder would either require further processing or disposal to landfill. Therefore, a dirty MRF is most effectively used as pre-treatment prior to residual waste being treated by other technologies. For example, a form of MRF is required prior to residual waste being treated by an Energy from Waste (EfW) technology.

It is desirable that Dirty MRF plants generally are located near to the source of waste with good transport links to minimise costs. A typical scale for this process is 50,000-100,000 tpa.

Figure 2.2.4 - Schematic of Dirty MRF facility process



2.2.5 Mechanical Biological Treatment (MBT)

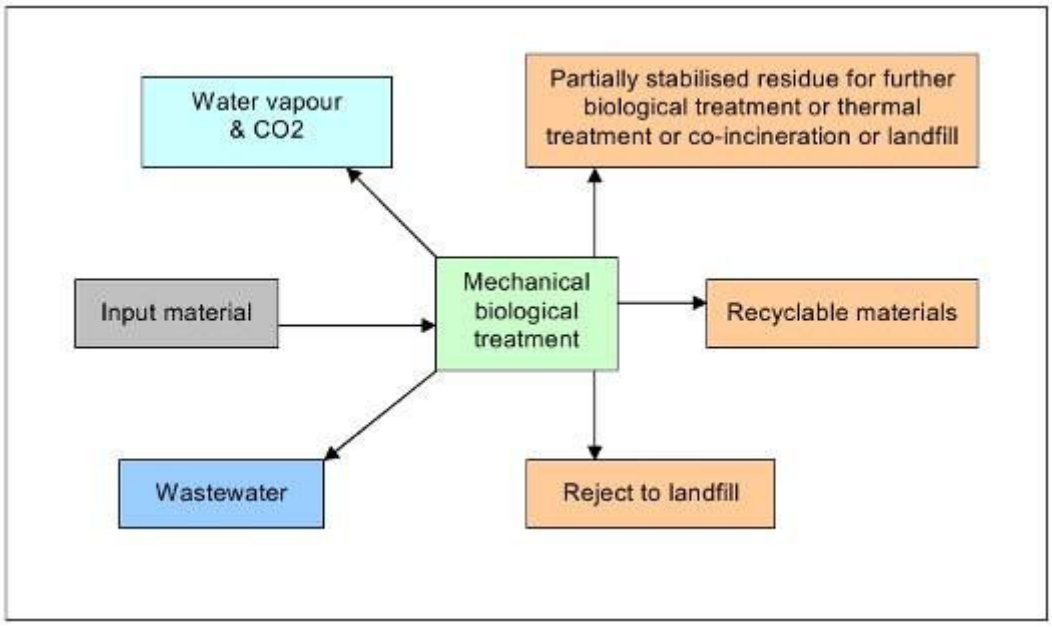
There are a number of proprietary MBT processes, whereby mixed household waste is treated by the mechanical removal of some constituents with the remainder being biologically treated. A residual fraction is produced which is smaller and generally stabilised for other uses, usually fuel for EfW plants.

MBT therefore typically involves the drying, stabilisation, separation and derivation of a reusable product. The objective of MBT is to minimise the environmental impact associated with a significant reduction in volume, as a pre-treatment prior to the end treatment/disposal of wastes and to obtain value from recovery of recyclable materials.

MBT is often seen as an alternative to Energy from Waste (EfW) and is perceived to have greater dependability and bankability than thermal technologies. Although this may be the perception it should more sensibly be seen to be an intermediate technology, requiring an end use as a fuel or disposal option for the stable end product. It should not be assumed to be a final treatment as the product produced will need to be heat treated to produce electricity, heat or power. If it is landfilled as a stable product it will be subject to the same disposal costs and taxes as untreated residual waste. A major constraining factor is securing market outlets for the product. It should also be noted that MBT processes can produce some wastes which cannot be recycled or used as a fuel, therefore precluding its use alone as a zero waste option.

As MBT does not recover all the potential resources provided within the residual municipal waste stream there may be difficulties in supporting a sustainable argument for its use if the waste infrastructure does not include energy recovery from the MBT outputs.

Figure 2.2.5 - Schematic of MBT facility process



2.2.6 Mechanical Heat Treatment (MHT)

Mechanical Heat Treatment (MHT) is a waste treatment technology which has been around for many years for the treatment of Clinical Waste. In recent years it has been developed for the treatment of MSW. It reputedly reduces the volume of waste by 60 to 70% by combining steam heat process with a number of separation techniques.

Waste is processed in a pressurised container under the action of steam. Afterwards, the sterilised waste is easily separated into clean recyclable materials (glass, metals and plastics), Refuse Derived Fuel (RDF) and organic fibre. RDF/Solid Recovered Fuel (SRF) can be used for energy generation while organic fibre requires further treatment for use as compost. Organic fibre produced from residual municipal waste will tend to contain contaminants that preclude the agricultural use of the compost produced.

A disadvantage is the amount of heat and other energy required by the pressurisation process; however MHT is often combined with other waste treatment technologies. In order to ensure that the necessary heat and power for pressurisation are available on

site, a power generating technology may be chosen. Therefore, MHT plants generally need to be located close to existing waste management facilities.

MHT involves a mechanical sorting or pre-processing stage with technology often found in a material recovery facility. The mechanical sorting stage is followed by a form of thermal treatment. This might be in the form of a waste autoclave or processing stage to produce a refuse derived fuel pellet. MHT technology is sometimes included within a Mechanical Biological Treatment plant.

2.2.7 Energy from waste (EfW)

EfW plants are typically designed to combust MSW to reduce the hazardous properties and volume of the waste while at the same time generating electricity, heat and power. Although many EfW plants can accept MSW without any pre-treatment, the recent Zero Waste Scotland Regulations Policy Statement issued by the Scottish Government indicates that a provision will be included in the Regulations requiring best available techniques be used to remove marketable recyclate from residual municipal waste prior to incineration. This will result in the production of a more uniform feedstock suitable for the EfW technology being used, maximising the recyclable materials being recovered and a reducing the scale of the EfW plant.

EfW plants require extensive control of emissions and application of flue gas cleaning technologies. Residues produced by the facilities are generally bottom ash (disposed of to landfill or used in construction) and flue gas treatment residues which may need specialised disposal treatment.

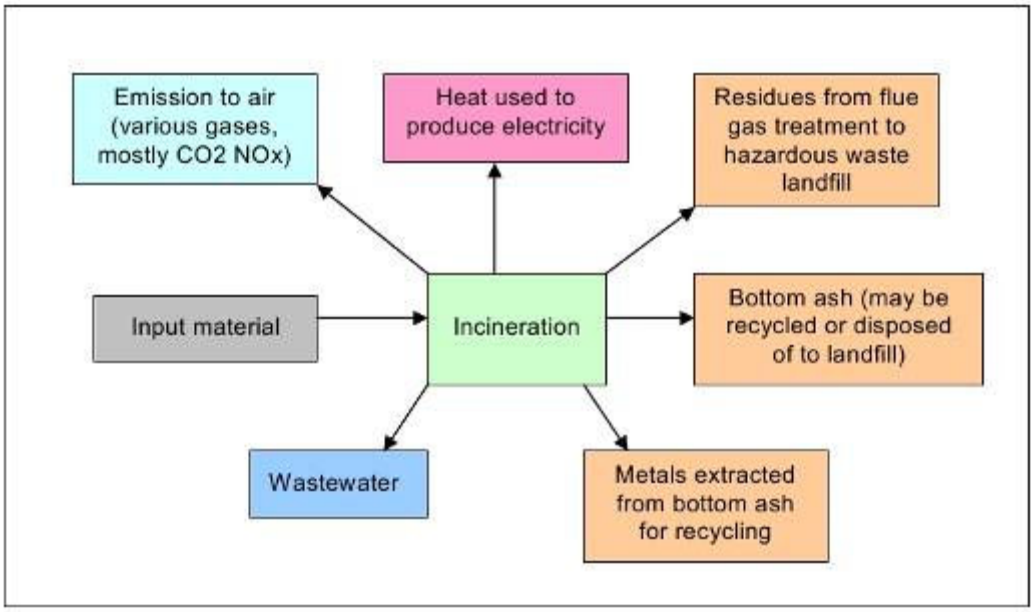
Incineration

The major types of incineration plant are:

Moving grate – waste is mechanically propelled through the furnace for combustion. Such plants typically process 45,000 – 200,000 tpa of wastes and are proven and reliable incinerator technologies.

Fluidised Bed – these systems treat pre-sorted materials, milled to reduce the particle size, the waste moves through the furnace by the action of the bed which is "fluidised" by the action of air.

Figure 2.2.7.1 - Schematic of Incineration facility process

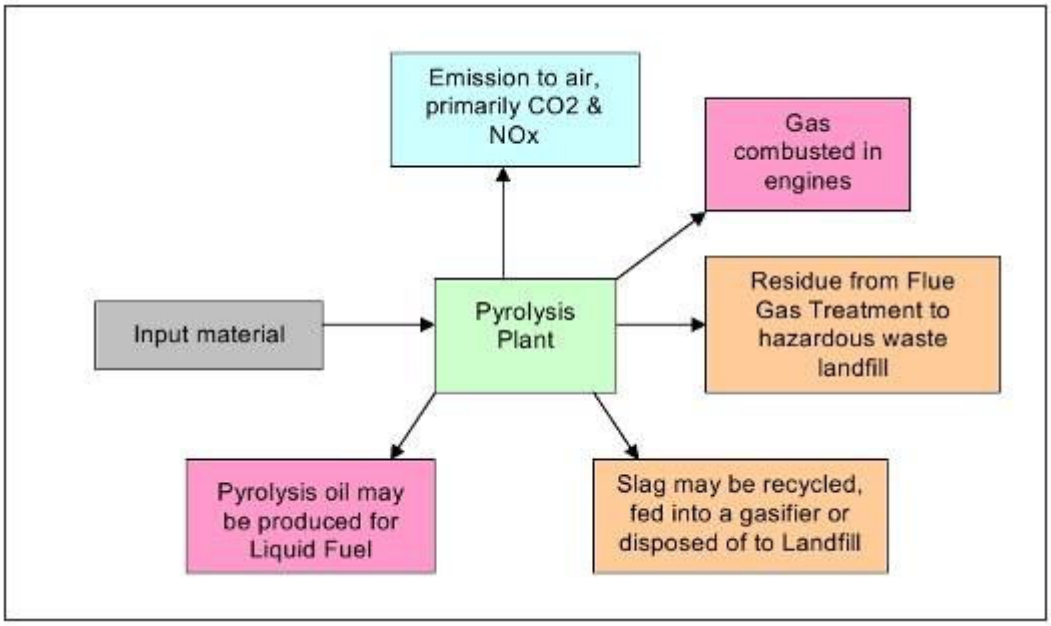


Pyrolysis

Pyrolysis involves the use of temperatures between 400-700 degrees C to break down pre-sorted and mechanically homogenised organics in the absence of oxygen. Pyrolysis technologies would be suitable for the treatment of Refuse Derived Fuel (RDF) sometimes referred to as Solid Recovered Fuel (SRF) and could form part of an integrated system with a Mechanical Biological Treatment (MBT) plant.

The product of pyrolysis is syngas, which can be condensed to form an oil to generate electricity or fuel engines, and a char which needs specialist disposal, for example in a gasification plant. Pyrolysis as a heat treatment process for residual municipal waste is within the Alternative Thermal Treatment (ATT) group and as such is not fully tried and tested for this use. It will require a robust due diligence before being procured as a solution for residual MW treatment.

Figure 2.2.7.1 - Schematic of Pyrolysis facility process



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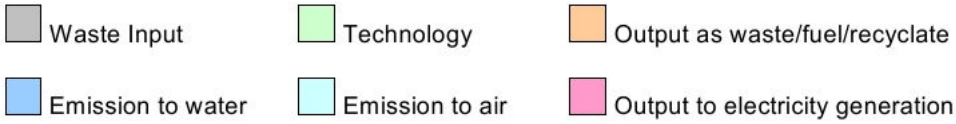


Gasification

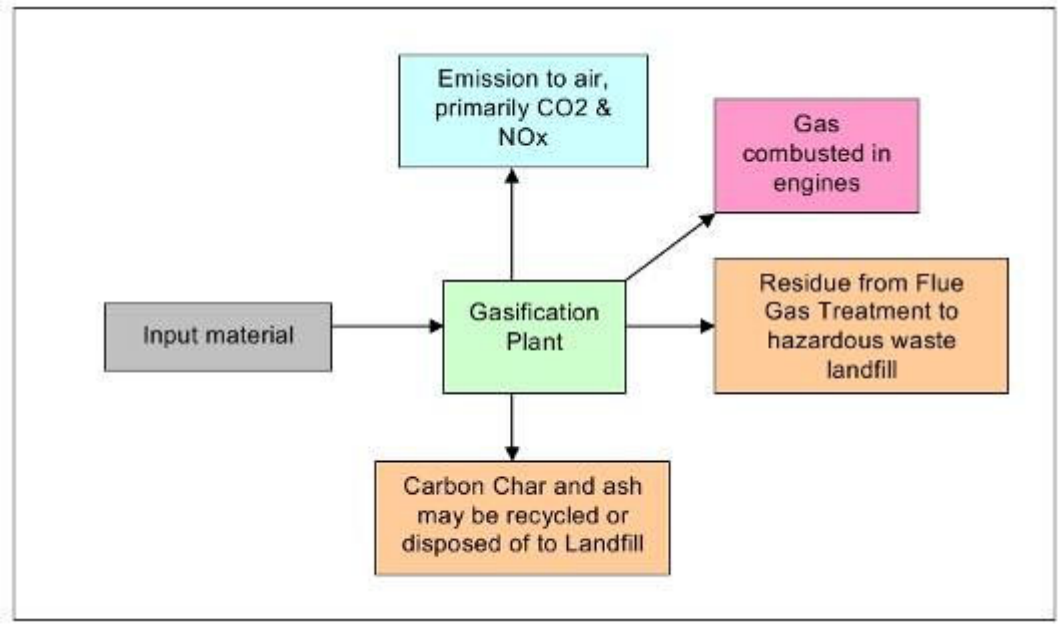
Gasification plants operate at higher temperatures (800-1200 degrees C), than pyrolysis plants and also differ in that they require the addition of air and water to the feedstock, albeit the by-products are again a syngas and ash.

Some of the perceived benefits of the technology have been reported as unfounded, for example a significant proportion of the recycling rate improvements are due to front end technologies rather than the Advanced Thermal Treatment (ATT) systems. There is still some perceived technology risk and their limited track record may affect their bankability, potential to attract private finance, and the availability of detailed Capex and Opex costs.

There is some attractiveness however in their smaller scale and the likelihood of attracting ROCs. Their potential viable operation at a smaller, 30,000-60,000 tpa, scale does confer advantages in terms of the proximity principle, local operation and public perception. There is however a high operation risk.

Scotgen Dumfries Ltd (Ascot Environmental Limited) is currently commissioning its ATT plant (gasification) with Combined Heat and Power (CHP) capability at Dargavel, Dumfries. In addition to this plant there is a gasification plant in the Isle of White and a plant in Bristol that combines both gasification and pyrolysis.

Figure 2.2.7.2 - Schematic of Gasification facility process



Plasma

The use of plasma arc technologies for the treatment of residual MSW is new and has only been carried out at the research and demonstration stage with only 2 plants currently operational in Japan. At this stage in its development gas plasma does not have a robust history for the treatment of residual MSW in the UK.

In this process, waste is not burned. A plasma waste converter uses a gas and powerful electrodes to create plasma. Plasma is an ionized gas which generates a magnetic field. This process generates high temperatures of 5,000oC to 15,000oC resulting in the molecular dissociation of waste.

The product of Plasma Gas is a syngas, which can be condensed to an oil to generate electricity or run engines. The heat produced could be used to power a steam turbine, generating more electricity. The solid residue can be used, after further treatment, to potentially produce construction materials.

Plasma arc gasification plants are operational in Japan, however data were not available to adequately support this review.

A trial gasplasma facility is operating in Swindon. Gasplasma is the sequential use of gasification, plasma gas treatment, syngas polishing and gas engine power generation.

The principle of Combined Heat & Power (CHP) is to recover and make beneficial use of the heat produced during residual waste treatment that generates energy resulting in higher efficiency from the plant. The electricity produced can easily be supplied into the national grid and therefore sold and distributed. Heat will need to be used locally to the plant. The use of heat will therefore be dependent on identifying and establishing a local need, e.g. a district heating system for buildings/housing and/or supply of heat to a factory for industrial use.

The electrical and thermal generating efficiencies will vary depending on the split between the two forms of energy (heat and power). However, the very best CHP schemes can achieve fuel conversion efficiencies of about 90%.

The main technologies used in current UK CHP schemes are gas engines, gas turbines, steam turbines, combined cycle gas turbines and absorption chilling.

2.2.8 Thermophilic Aerobic Digestion (TAD)

Thermophilic aerobic digestion is a composting process which can be used to treat food or other organic materials in liquid slurry or semi-solid form (WRAP website)

The process - Feedstock is fed into a digester where air is forced through the material to encourage the growth of aerobic microbes. The process is exothermic and the heat is maintained at thermophilic conditions of between 55-65 degrees C. The retention time of the process is usually between 2 and 5 days, as degradation is rapid. Following digestion the digestate is usually dewatered or dried. The output is bio-fertiliser.

Uses - TAD has been used in the wastewater industry for the treatment of sewage sludges and for treating agricultural slurry wastes. Its use is relatively new for food waste, although there are some small pilot-scale plants in the UK and some commercial plants in development.

3 References

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Appendix A

Assessment Criteria

Appendix A Assessment criteria

A.1 Anaerobic Digestion (AD)

Criteria reviewed:

- **whether the technology is proven, has a significant commercial operating history of an appropriate scale, significant track record of operation and of treating similar waste streams commercially;**

Anaerobic digestion is a proven technology for treating sewage sludge, agricultural residues and industrial organic wastes.

While it has not generally been used for treatment of mixed residual municipal waste in the UK, the practice is increasingly common in Europe. In Scotland there is a plant currently operational in the Western Isles for the treatment of mixed residual municipal waste. This facility receives source segregated MSW from collection schemes (glass, plastics, organics and residuals). The residual waste fraction is fed through a mechanical pre-sorting system and any contaminants are removed before being fed in to two heated buffer tanks, macerated and then on to the digester. This is operated at thermophilic temperatures to meet the requirements of the Animal By-Products (Scotland) Regulations. Biogas is continually drawn off and used to supply a CHP unit for process heat and electricity generation. Compost is fed through two HotRot composting tunnels.

- **impact of the animal-by-products legislation;**

Food wastes may be treated only if the plant is compliant with Animal By-Products (Scotland) Regulations 2003 (as amended).

- **process type**

Waste is collected and brought to the site where it is pre-treated to remove non-biodegradable materials such as plastics, metals and stones, and shredded to a uniform size in order to aid digestion. The biodegradable materials are transferred to an enclosed, oxygen free, warmed container. Bacteria then digest the waste, which can take from 12-30 days, producing biogas. The digested matter, or digestate, is then pumped into a storage tank where biogas continues to be produced. The residual digestate can then be separated to produce fibre and liquor, which must be refined for use in horticulture or agriculture. Material going to landfill is stabilised and compacted in order to reduce leachates, dust and odour when it is in landfill. The waste water, which is high in nitrates, should be treated.

- **input type(s) being processed;**

- BMW, sewage sludge, agricultural residues, food waste, garden waste and industrial organic wastes.

- **outputs produced**

- Energy recovery potential (biogas)

- Bio-fertiliser

- **typical plant footprint;**

- Estimated 1m² per tonne

- **potential regulatory, planning and environmental issues;**

PAS 110

"BSI PAS110:2010 Specification for whole digestate, separated liquor and separated fibre derived from the anaerobic digestion of source-segregated biodegradable materials" creates an industry specification against which producers can verify that the digested materials are of consistent quality and fit for purpose. In order to fully comply with the end of waste criteria, the "SEPA position statement: the use of PAS 110 certified Digestate from Anaerobic Digestion" also has to be followed. If an AD plant meets the specification and complies with the position statement, its digestate will be regarded as having been fully recovered and to have ceased to be waste, and it can be sold with the name "Bio-fertiliser". REAL (Renewable Energy Assurance Limited) manage the Biofertiliser Certification Scheme for PAS110.

In Scotland under the Zero Waste Plan (launched in June 2010) digestate which is not PAS110 certified and produced in accordance with the SEPA position statement, will not be counted towards recycling targets even if it is currently produced and used under an exemption.

Pollution Prevention Permit (PPC)

It is likely that an Anaerobic Digestion Plant, treating Directive Waste, will require a Pollution Prevention Permit in order to operate.

Planning Permission

The plant will require to operate under a planning consent

- **consideration of the ability of the technology to qualify for Renewable Obligation Certificates (ROCs)**

Eligible for ROCS and complies with National Recycling/Recovery objectives

A.2 In Vessel Composting (IVC)

Criteria reviewed:

- **whether the technology is proven, has a significant commercial operating history of an appropriate scale, significant track record of operation and of treating similar waste streams commercially;**

There are several IVC plants in the UK including one in Lanarkshire, two in Aberdeenshire, one in Fife, three in Argyle & Bute and one in the Highlands.

- **impact of the animal-by-products legislation;**

Animal-by-Products (Scotland) (ABP) (SSI 2003/411) establishes health rules concerning animal by-products not intended for human consumption and applies to food waste that is composted.

Under the UK treatment standards for in-vessel composting "catering waste" can be either 'meat included' or 'meat excluded'. 'Meat-excluded' requires a one stage

barrier system to treat, plus 18 days storage. 'Meat-included' requires a two stage system.

- **process type**

Waste is collected and bought to the site where it is initially sorted to remove any non-biodegradable waste and shredded to a consistent size. It is then put into a closed reactor where the composting process is speeded up through the management of water, air and heat. This process typically takes between 7 and 21 days. The material is then subject to screening to remove any traces of metals and other contras before a maturation period of up to 10 weeks. The product can then be used as compost or soil conditioner.

- **input type(s) being processed;**

Biodegradable Municipal Waste (BMW), agricultural waste and food processing wastes. Food wastes may be treated only if the plant is compliant with Animal By-Products (Scotland) (SSI 2003/411). Ideally this process should treat only segregated biodegradable waste. Mixed waste can be treated by anaerobic digestion; however this may result in contamination of the liquid and solid fractions which can make them less suitable as soil conditioners or fertilisers.

- **markets for outputs produced**

- Emissions (mainly water vapour and carbon dioxide (CO2));

- Compost;

- Residual to landfill (depending on contamination level of waste); and

- Wastewater which can be treated or re-circulated on site or treated at a sewage treatment works

- **typical plant footprint;**

A typical large-scale plant treating 200,000tpa would have a site area of approximately 5-6 ha. A typical medium-scale plant treating 25,000tpa would have a site area of approximately 1-2ha with a maximum building height of 5m.

- **potential regulatory, planning and environmental issues;**

PAS 100

BSI PAS 100 is the national compost benchmark. It sets out the minimum requirements for the process of composting, the selection of materials from which compost is made and even how it is labelled. BSI PAS 100 stands for the British Standards Institution's Publicly Available Specification for composted material. This specification was launched in November 2002 and was developed jointly by WRAP and The Association for Organics Recycling (formerly the Composting Association).

The Standard covers the whole of the life cycle by which compost is produced from the production methods, through to quality control and laboratory testing. The material must be sampled and tested to make sure that the product is compliant with the BSI PAS 100 criteria and therefore is fit for use. PAS 100 is only for biodegradable materials that have been kept separate from non-biodegradables. It applies to

composted materials produced at centralised, on-farm and community composting facilities; it does not extend to end products of home composting for self-use.

In Scotland and Northern Ireland, compost produced to BSI PAS 100 is considered a product and is therefore free of any additional regulatory controls.

Pollution Prevention Permit (PPC) or Waste Management Licence

It is likely that an In-Vessel Composting Plant, treating Directive Waste, will require a either a Waste Management Licence or Pollution Prevention Permit in order to operate.

Planning Permission

The plant will require to operate under a planning consent.

- **consideration of the ability of the technology to qualify for Renewable Obligation Certificates (ROCs)**

Not eligible for ROCs

A.3 Open Windrow Composting

Criteria reviewed:

- **whether the technology is proven, has a significant commercial operating history of an appropriate scale, significant track record of operation and of treating similar waste streams commercially;**

There are currently a significant number of open windrow facilities operating successfully in Scotland.

- **impact of the animal-by-products legislation;**

Food Wastes are not permitted to be treated via open windrow composting

- **process type**

Waste is collected and brought to the site where it is checked to ensure it is of sufficient quality. It is then shredded and piled into windrows, which are elongated piles shaped for ideal composting. Aeration is encouraged by suitable mixing of the initial material and regular mechanical agitation (turning). Decomposition is allowed to continue until the waste has been stabilised and matured. Before use, the compost is checked for contaminants to ensure that it fulfils the physical, chemical and biological requirements for commercial compost.

- **input type(s) being processed;**

- Garden Waste, ideally this process should treat only segregated biodegradable garden waste.

- **outputs produced**

- Gas emissions including CO2, Water vapour and methane;

- Compost – use dependent on quality of the material; and

- Residual waste to landfill.

- **typical plant footprint;**

A typical large-scale plant treating 25,000tpa would have a site area of approximately 2-3 ha. The height of windrows is usually no more than 3m high dependant on type of windrow turning machinery used.

- **potential regulatory, planning and environmental issues;**

PAS 100

BSI PAS 100 is the national compost benchmark. It sets out the minimum requirements for the process of composting, the selection of materials from which compost is made and even how it is labelled. BSI PAS 100 stands for the British Standards Institution's Publicly Available Specification for composted material. This specification was launched in November 2002 and was developed jointly by WRAP and The Association for Organics Recycling (formerly the Composting Association).

The Standard covers the whole of the life cycle by which compost is produced from the production methods, through to quality control and laboratory testing. The material must be sampled and tested to make sure that the product is compliant with the BSI PAS 100 criteria and therefore is fit for use. PAS 100 is only for biodegradable materials that have been kept separate from non-biodegradables. It applies to composted materials produced at centralised, on-farm and community composting facilities; it does not extend to end products of home composting for self-use.

In Scotland and Northern Ireland, compost produced to BSI PAS 100 is considered a product and is therefore free of any additional regulatory controls.

Waste Management Licence

An open windrow composting process requires to operate under the control of a waste management licence.

Planning Permission

The plant will require to operate under a planning consent.

- **consideration of the ability of the technology to qualify for Renewable Obligation Certificates (ROCs)**

Not eligible for ROCs

A.4 Dirty Materials Recycling Facility (Dirty MRF)

Criteria reviewed:

- **whether the technology is proven, has a significant commercial operating history of an appropriate scale, significant track record of operation and of treating similar waste streams commercially;**

Dirty MRFs have had limited success in the UK as a standalone treatment solution, largely due to poor levels of income from recyclate and the volatility of the recycling market.

- **impact of the animal-by-products legislation;**

Any biodegradable stream derived from plant will be subject to the Animal-by-products legislation.

Animal-by-Products (Scotland) (SSI 2003/411) establishes health rules concerning animal by-products not intended for human consumption and applies to food waste that is composted

- **process type**

Waste is deposited at the plant where it is separated through a system of conveyer belts, screening and other sorting systems. The type of separation process utilised depends largely on both input and after use of the separated materials. After the materials have been sorted they can be bulked and transported for further processing or as a front end sorting process on site for further treatment e.g. EfW, Mechanical Biological Treatment (MBT) etc.

- **input type(s) being processed;**

Dirty MRF facilities can process mixed municipal, commercial and industrial waste.

- **outputs produced**

- Dirty MRF will typically recover material that is recyclable such as metal, plastic, glass paper and card although paper and card tends to be highly contaminated and unsuitable for recycling.;

- Organic outputs from a dirty MRF will usually be contaminated and of limited value; and

- Residue to treatment.

- **typical plant footprint;**

A typical plant treating 50,000tpa would have a site area of approximately 1-2ha with a building height of 12m.

- **potential regulatory, planning and environmental issues;**

Waste Management Licence

A Dirty MRF process requires to operate under the control of a waste management licence.

Planning Permission

The plant will require to operate under a planning consent

- **consideration of the ability of the technology to qualify for Renewable Obligation Certificates (ROCs)**

Not eligible for ROCS

A.5 Mechanical Biological Treatment (MBT)

Criteria reviewed:

- **whether the technology is proven, has a significant commercial operating history of an appropriate scale, significant track record of operation and of treating similar waste streams commercially;**

There are over 70 MBT plants working in Europe, and there are a number of MBT plants operating in the UK including three in Argyll and Bute and one in Dumfries and Galloway.

- **impact of the animal-by-products legislation;**

Food waste may be treated only if the MBT plant is compliant and complies with Animal-by-Products (Scotland) (SSI 2003/411).

Animal-by-Products (Scotland) (SSI 2003/411) establishes health rules concerning animal by-products not intended for human consumption and applies to food waste that is composted.

- **process type**

The MBT process and outputs depend greatly upon securing markets or a treatment process for the output product. However, the process generally follows one of two routes. Waste is collected and brought to the site where it can then be treated mechanically then biologically, or biologically then mechanically. Waste is treated mechanically in order to reduce its volume, provide a uniform feedstock and separate it into different waste fractions. The biodegradable fraction of the waste is treated in a managed biological process in which it is broken down by naturally occurring micro-organisms. The organic output may have a higher level of contaminants (for example plastics and glass) than other biological treatment processes which only treat biodegradable waste, such as Open Windrow Composting, IVC or Anaerobic Digestion.

- **input type(s) being processed;**

These tend to be unsorted Municipal Waste and solid non-hazardous waste. MBT is sometimes referred to as a "dirty MRF" as it processes mixed household waste. This is in contrast to "clean MRF" which is associated with processing of dry recyclable materials.

- **outputs produced**

- Water vapour & CO2;

- Recyclable materials;

- Organic output – use as compost is dependent on quality of the material. This material may also be used to make refuse derived fuel (RDF);

- Residual waste to landfill;

- Leachate.

- **typical plant footprint;**

A typical plant treating 50,000tpa would have a site area of approximately 1-2ha with a maximum building height of 20m.

- potential regulatory, planning and environmental issues;

Pollution Prevention Permit (PPC)

It is likely that an MBT Plant, treating Directive Waste, will require a Pollution Prevention Permit in order to operate.

Planning Permission

The plant will require to operate under a planning consent.

- **consideration of the ability of the technology to qualify for Renewable Obligation Certificates (ROCs)**

Not eligible for ROCs unless it incorporates a heat treatment process for the production of electricity, heat or power.

A.6 Mechanical Heat Treatment (MHT)

Criteria reviewed:

- **whether the technology is proven, has a significant commercial operating history of an appropriate scale, significant track record of operation and of treating similar waste streams commercially;**

Since June 2008, Sterecycle has been operating a full scale plant in Rotherham, South Yorkshire that is capable of treating 100,000 tonnes per annum of waste. This is the world's first full scale commercial autoclave plant capable of treating residual household waste. The plant is processing "black-bag" waste from three local authorities under a contract for up to ten years: Rotherham Metropolitan Borough Council, Barnsley Metropolitan Borough Council and Doncaster Metropolitan Borough Council. However a major incident occurred in the plant recently and if being considered further due diligence would be required. The product produced by MHT will require heat treatment to produce electricity, heat or power.

- **impact of the animal-by-products legislation;**

Not applicable as the process involves high temperatures.

- **process type**

Waste is collected and brought to the site where it is placed in a pressurised container called an autoclave and then "cooked" using steam. The process is effective in killing off viruses and pathogens and transforming the physical characteristics of the waste. The waste is then easily separable into recyclates, Refuse Derived Fuel (RDF) and organic fibre. After separation glass, metals and plastics are cleaned and can then be sent on for further treatment. RDF can be used for energy, heat or power generation. The organic fibre requires further treatment for use as compost.

- **input type(s) being processed;**

Unsorted or separated Municipal Waste, commercial waste, clinical waste and certain industrial wastes.

- **outputs produced**

- Organic fibre, which can be blended and used as a soil conditioner subject to contamination levels.

- Recyclable materials

- RDF/SRF may also be produced from the organic fibre and residual waste

- **typical plant footprint;**

Plant size may be variable. A typical plant treating 100,000tpa would have a site area of approximately 1.8 hectares.

- **potential regulatory, planning and environmental issues;**

Pollution Prevention Permit (PPC)

It is likely that a Mechanical Heat treatment Plant, treating Directive Waste, will require a Pollution Prevention Permit in order to operate.

Planning Permission

The plant will require to operate under a planning consent.

- **consideration of the ability of the technology to qualify for Renewable Obligation Certificates (ROCs)**

Not eligible for ROCs unless it incorporates a heat treatment process for the production of electricity, heat or power

A.7 Energy from Waste (EfW)

Incineration

Criteria reviewed:

- **whether the technology is proven, has a significant commercial operating history of an appropriate scale, significant track record of operation and of treating similar waste streams commercially;**

It is a common technology in Europe, and there are a number of plants operating in the UK including plants in Lerwick, Shetland and Dundee.

- **impact of the animal-by-products legislation;**

Not applicable as the waste is heat treated at high temperatures.

- **process type**

Waste is collected and delivered to the site where it is deposited in a bunker and will now have to be treated to remove glass and plastics before being mixed to ensure a more consistent and even calorific mix of feed stock. It is then fed into a furnace where it is burned. There are a number of different furnace designs: the furnace may

use oscillation, rotation, or a grate system to ensure a more even burn, or may use fluidised beds to create turbulence in order to maximise combustion of waste. The residue, known as bottom ash, is stabilised and is deposited into a tank. Magnets remove any ferrous metals from the ash for recycling, and the remaining ash can be recycled for use in construction. The hot gasses produced during combustion are then directed to a boiler where steam can be generated for electricity production and heat recovered. Gases are thoroughly cleaned using a range of emission control systems before they are emitted to the atmosphere. Filtered particles are collected and sent to hazardous waste landfill. Under the Waste Incineration (Scotland) Regulations 2003 emissions are continuously monitored and recorded.

- **input type(s) being processed;**

Incineration can treat a wide range of waste types including Municipal Waste (MW), industrial waste, and Refuse Derived Fuel (RDF). While large-scale plants can treat unsorted waste, small-scale plants are specifically designed to take a relatively homogenous, pre-processed feedstock.

- **outputs produced**

- Air pollution control residues which are classified as hazardous waste and landfilled or potentially stabilised to produce materials for the building industry;

- Bottom ash for recycling or landfill;

- Metals extracted from bottom ash for recycling;

- Waste water for treatment on site and discharged under consent or via a sewage treatment plant;

- Electricity and Heat: approximately 2,000 kilowatt hours of heat per tonne of waste can be recovered, of which 90% is available for export once a certain fraction has been used for running the plant; and

- Emissions to air, various gases, mostly CO2, NOx

- **typical plant footprint;**

A typical small-scale plant treating up to 90,000tpa would have a site area less than 2ha, with a maximum building height of 25m. A typical large-scale plant treating approximately 400,000tpa would have a site area of approximately 5ha, with a maximum building height of 30m. The stack height for both small and large-scale plants may be very similar, around 40-70m, due to requirements for air dispersion

- **potential regulatory, planning and environmental issues;**

Pollution Prevention Permit (PPC)

It is likely that an Energy From Waste Plant will require a Pollution Prevention Permit in order to operate.

Waste Incineration (Scotland) Regulations (SSI2003/170)

An Energy From Waste Plant will require to comply with the full requirement of the above regulations.

Planning Permission

The plant will require to operate under a planning consent.

- **consideration of the ability of the technology to qualify for Renewable Obligation Certificates (ROCs)**

Currently Eligible for ROCS and complies with National Recycling/Recovery objectives.

The Scottish Government recently issued a consultation document reviewing the level of ROC support for eligible technologies. Within the consultation document it is proposed that from April 2013 ROC support for Energy from waste with CHP will be reduced from 1 ROC to 0.5 ROC.

Gasification

Criteria reviewed:

- **whether the technology is proven, has a significant commercial operating history of an appropriate scale, significant track record of operation and of treating similar waste streams commercially;**

There is currently a gasification plant treating MW in Dumfriesshire, Scotland (Scotgen), a gasification plant in the Isle of White (Energos) and plant in Bristol that combines both Gasification and Pyrolysis.

- **impact of the animal-by-products legislation**

Not applicable as there are high temperatures involved in the processes.

- **process type**

Pre-treated waste (shredding and removal of metals) is fed into the gasification reactor where the waste is treated at high temperatures of the order of 800-1200 degrees C and by the addition of air and water to produce syngas. The second stage is the high temperature oxidation of the syngas. This gas can be used at the plant to generate electricity and/or heat, or can be refined, using a system of scrubbers and cleaners, to produce a highly efficient gas which can be further scrubbed of pollutants for combustion on-site or transported to other energy generation sites.

The residue, or bottom ash, from the non-organic fraction of MW is stabilised and is deposited into a quench tank. Magnets remove any ferrous metals from the ash for recycling and the remaining ash may be recycled for use in construction.

- **input type(s) being processed;**

Gasification can treat MW and other waste types including commercial, industrial and clinical waste.

- **outputs produced**

- Ash residue for use in construction or landfill;

- Hazardous waste to landfill; and

- Syngas.

- **typical plant footprint;**

A plant treating approximately 50,000tpa would have a site area of approximately 1-2ha with a maximum building height of 25m. The stack height will depend upon the requirements for air dispersion, but may range from 30-70m.

- **potential regulatory, planning and environmental issues;**

Pollution Prevention Permit (PPC)

It is likely that a Gasification Plant will require a Pollution Prevention Permit in order to operate.

Waste Incineration (Scotland) Regulations (SSI2003/170)

It is likely that a Gasification Plant will require to comply with the full requirement of the above regulations.

Planning Permission

The plant will require to operate under a planning consent.

- **consideration of the ability of the technology to qualify for Renewable Obligation Certificates (ROCs)**

Currently eligible for ROC support

The Scottish Government recently issued a consultation document reviewing the level of ROC support for eligible technologies. Within the consultation document it is proposed that from April 2013 ROC support for standard gasification plants will be reduced from 1 ROC to 0.5 ROC.

Pyrolysis

Criteria reviewed:

- **whether the technology is proven, has a significant commercial operating history of an appropriate scale, significant track record of operation and of treating similar waste streams commercially;**

There are currently no pyrolysis plants treating MW in Scotland; however there is a plant in Bristol that combines both Gasification and Pyrolysis.

- **impact of the animal-by-products legislation;**

Not applicable due to the high temperatures involved.

- **Process type**

Waste is collected and delivered to the site where it is pre-treated to remove non-combustibles such as glass and metal, remove excess moisture, and sometimes shredded to a uniform size. It is then fed into the pyrolysis reactor. The residue, or char, from the non-organic fraction of MW is stabilised and is deposited into a quench tank. Magnets remove any ferrous metals from the ash for recycling and the remaining ash maybe recycled for use in construction. The combustion process also produces carbon which is transformed into syngas. This can be refined, using a system of scrubbers and cleaners in order to remove tar, sulphur compounds and

other acid gases, which are then sent to landfill. This produces a highly efficient gas for combustion on-site or transported to other energy generation sites.

- **input type(s) being processed;**

Pyrolysis can treat MW and other waste types including commercial and industrial waste, and clinical waste.

- **outputs produced**

- Char for use in construction or landfill;

- Hazardous waste for landfill; and

- Syngas. This provides a high efficiency energy generation in comparison with other heat treatment facilities,

- **typical plant footprint;**

A plant treating approximately 50,000tpa would have a site area of approximately 1-2ha, with a maximum building height of 25m. The stack height will depend upon the requirements for air dispersion, but may range from 30-70m.

- **potential regulatory, planning and environmental issues;**

Pollution Prevention Permit (PPC)

It is likely that a Pyrolysis Plant will require a Pollution Prevention Permit in order to operate.

Waste Incineration (Scotland) Regulations (SSI2003/170)

It is likely that a Gasification Plant will require to comply with the full requirement of the above regulations.

Planning Permission

The plant will require to operate under a planning consent.

- **consideration of the ability of the technology to qualify for Renewable Obligation Certificates (ROCs)**

Currently eligible for ROC support

The Scottish Government recently issued a consultation document reviewing the level of ROC support for eligible technologies. Within the consultation document it is proposed that from April 2013 ROC support for standard gasification plants will be reduced from 1 ROC to 0.5 ROC.

Renewable Heat Incentive (RHI)

The RHI is a government scheme that provides financial support to non-domestic renewable heat generators and producers of bio-methane. It is intended that the following technologies will be included in the scheme:

- Biomass boilers (Including CHP biomass boilers)

- On-Site Biogas combustion (must be from anaerobic digestion, gasification or pyrolysis
- Energy from Municipal Solid Waste
- Injection of biomethane into the grid

The RHI provides a continuous income stream for twenty years to any organisation that installs an eligible renewable heating system, ensuring that renewable heat is commercially attractive when compared to fossil fuel alternatives. The RHI is important because it will help increase significantly the level of renewable heat produced in the UK, which is key to the UK meeting its renewable energy targets, reducing carbon emissions, ensuring energy security and helping to build a low carbon economy. The RHI will accelerate deployment by providing a financial incentive to generate heat from renewables instead of fossil fuels.

The key objective of the scheme is to increase significantly the level of heat generated from renewable energy sources in Great Britain and thereby enable the UK to meet its binding targets to generate 15% of our energy from renewable sources by 2020.