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Briefing Paper

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Title:	

THE CHALLENGE AHEAD

:

Finding Outlets for MBT Outputs in Ireland

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Important Note:

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Introduction

This Briefing Paper is the second[1] prepared as part of a review commissioned by the Irish arm of CEWEP (the **C**onfederation of **E**uropean **W**aste-to-**E**nergy **P**lants); the aim of which is to raise awareness amongst policy makers of the key issues associated with **M**echanical-**B**iological **T**reatment (**MBT**) of waste.

Whilst the first paper assessed 10 general questions related to the use of MBT to manage residual household waste (e.g. *What is MBT? Can MBT be a total solution for Ireland? Are all types of MBT positive for the environment? Can MBT boost recycling?,* etc.), this paper focuses more specifically on the challenges related to the management of the outputs from MBT processes. These issues are faced by all countries that want to use MBT systems, though this paper also takes into account the particular circumstances in Ireland. It seeks to answer specific questions that relate to the potential applications for the output from MBT and, hence, address some of the confusion that exists in Ireland today.

1. Possible outlets for MBT outputs

1.1 **M**echanical-**B**iological **T**reatment (**MBT**) is a generic term for a variety of different process configurations that have widely varying performance and which generate outputs with very different properties.

1.2 These configurations can be classified into 4 broad categories according to the main outputs which they are optimised to produce:

- MBT that aims to produce a **S**olid-**R**ecovered **F**uel (**SRF**)[2];
- the Anaerobic Digestion (AD) variant of MBT producing **biogas and digestate**;
- MBT designed to make a **C**ompost-**L**ike **O**utput (**CLO**); and
- MBT that produces a **bio-stabilised output for landfilling**.

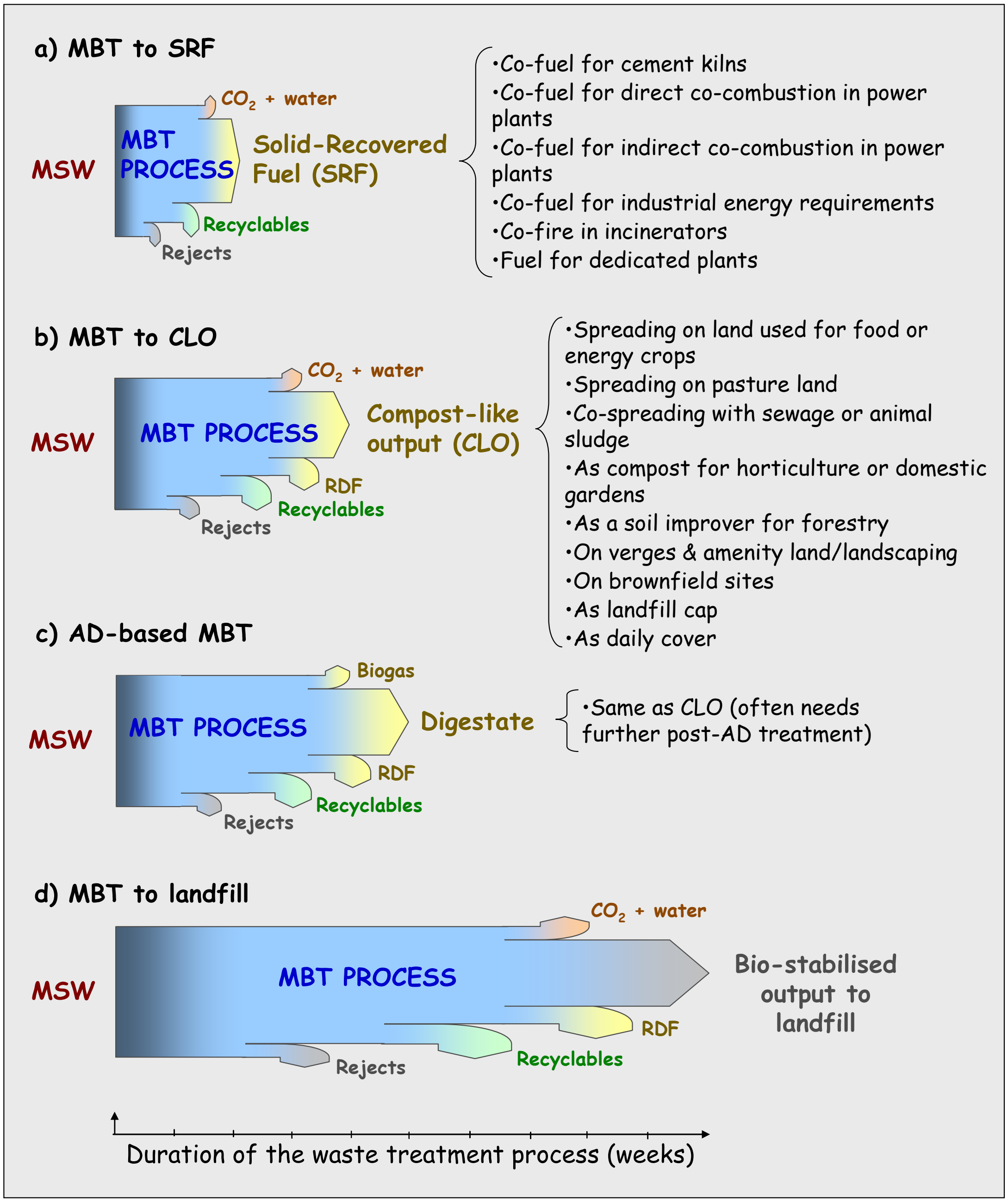
1.3 In Figure 1 we have listed some of the outlets for which the various MBT outputs are being targeted. Figure 2 provides an indication of the amounts of each output that could be typically produced.

1.4 Although the bio-treated fraction of waste from MBT processes could potentially be used in a broad range of applications, **there are technical, regulatory or commercial issues associated with all of the possible uses**. These issues, as they relate specifically to the viability of the different outlet routes in Ireland are summarised in Section 2, and are the subject of the remaining sections of this Briefing Paper.

[1] The first paper, “10 Questions on MBT”, was prepared by Juniper in October 2007.

[2] Typically this type of MBT utilises bio-drying (see paragraph 1.9). The implication is that the produced fuel will meet the European Committee for Standardisation, CEN/TC 343, standards for SRF, which gives technical specifications for the production and use of SRF (fuel derived from non-hazardous wastes). The standard categorises SRF fuels according to particle size, calorific value and levels of chlorine and mercury.

Figure 1. Outlet options for the main outputs from MBT



Source: Juniper

Figure 2. Typical breakdown of MBT outputs from various configurations as reported by MBT companies

Composition (wt.-% of input)	MBT to SRF	MBT to CLO	AD-based MBT	MBT to Landfill
SRF	35-50			
CLO		35-40		
Biogas			5-20	
Digestate			20-40	
Biostabilised output				20-40
RDF		15-40	10-45	30-50
Recyclables	3-8	3-8	3-20	3-20
Off-gases	20-30	15-35		10-20
Rejects	10-30	5-30	5-25	5-20
Wastewater	<1	<1	0-30	<1

Note: Values are strongly dependent on composition of the waste treated and the specific configuration of each plant.
Source: Juniper analysis of data from multiple sources

1.5 In addition to the main bio-fraction output, all MBT variants will also normally recover metals for recycling and a fraction of rejects (which is typically a mixture of hazardous items such as batteries, bulky materials and inerts, such as sand). With the exception of the MBT-to-SRF variant, all configurations produce a plastic-rich fraction, commonly referred to as RDF[3], which is separated from the input ahead of the biological stage. **The RDF fraction is usually significant in quantity (often >30% of the input waste) and, thus, finding a use for this material is highly desirable**.

1.6 It is not correct to think that MBT processes have no potential environmental impacts. Management of these also increases processing cost. MBT processes will generate off-gases, which mainly contain CO_2 (a greenhouse gas) and water vapour. These off-gases will also contain contaminants such as bioaerosols, ammonia and H_2S that should be abated before the off-gases can be discharged to atmosphere. Managing these off-gases can be costly depending upon the specific requirements of the regulator.

1.7 Many MBT plants produce wastewater/leachate that may require treatment. The raw wastewater usually contains various easily bio-degradable compounds (which makes it odorous), nitrates and organic acids, which will need to be managed and treated before discharge to sewer. Though this can be a significant on-cost, it would not normally result in any direct environmental impact, since there are standard techniques for managing liquid effluent. There are minor secondary impacts in terms of resource utilisation and energy consumption.

[3] **RDF** = **R**efuse **D**erived **F**uel. This phrase is used in a variety of different ways around the world depending upon the type of waste process. In an MBT sense the plastic rich fuel is normally called RDF and the bio-rich SRF, though from a formal perspective this differentiation is not used.

1.8 **The biologically treated fraction of waste usually represents the largest output from MBT, and it also presents the most uncertainties regarding the risk of finding viable, long-term outlets.** This briefing paper therefore focuses on the management of such outputs, the properties of which are highly dependent on the particular configuration of MBT employed.

1.9 **The MBT-to-SRF variant** of MBT utilises the biological activity of the waste to drive off moisture. This process, also commonly called bio-drying, is based on aerobic digestion, but does not involve water addition during the digestion phase; thereby limiting the extent to which the waste is composted. These processes usually take reasonably short periods of time, between 5 and 8 days, to complete as a high level of bio-stabilisation is not essential or desirable for an output intended to be combusted.

1.10 **The MBT-to-CLO variant aims to produce materials that could be used as 'compost' or a soil improver** in a variety of applications, ranging from agriculture to land remediation (as shown in Figure 1). As this output is intended to be used on land, greater stabilisation of its bio-content is necessary than for MBT-to-SRF. Processes may take from 6 days to 4 weeks to produce CLO. The length of time affects the quality of the output.

1.11 **The AD-based MBT variant produces biogas and a digestate**[4]. A significant portion of the non-biodegradable materials are usually separated prior to the digestion stage. AD differs from aerobic composting in that the degradation of biodegradable materials occurs in the absence of oxygen. The methane-rich biogas can be used as fuel without significant technical issues. The digestate, on the other hand, is unlikely to be utilised without further maturation. With this additional digestate maturation stage (used in the majority of AD-based MBT plants), the use of this output as CLO is possible. Landfilling is another potential outlet option. AD-based MBT processes have been designed for treatment cycles that range from a few weeks to a few months. Typically digestion takes place for about 3 weeks followed by a 2 to 4 week maturation step.

1.12 The **MBT-to-landfill variant is configured to significantly reduce the biodegradability of the waste input prior to landfilling.** The aim is to produce an output which, when landfilled, will have minimal CH_4-generating capacity. Treatment times typically range from 8 to 12 weeks. This configuration, which has received much attention in Ireland, may be regarded by some as not recovering the full resource value of the waste and, hence, may be regarded as sub-optimal from a sustainability perspective, despite being advocated by a number of enviromentalists.

1.13 MBT processes are often regarded as 'flexible' because they can be configured in so many different ways. However, there is an important difference between changing the process during the up-front design phase and changing them once the plant has been operating for some time. **There appears to be a growing misconception that because MBT is flexible, individual facilities can be readily altered from producing one type of outlet to producing a different type**: for example CLO to a bio-stabilised output for landfilling or CLO to SRF. This is not necessarily the case.

[4] Undigested materials, typically hard to degrade cellulosic matter and inorganics.

1.14 Such flexibility is desirable because of the issues associated with finding long-term outlets for certain MBT outputs. Thus, being able to switch configurations so that the MBT plant can respond to shifts in market demand for particular outputs would be highly beneficial. However, in practice, once an MBT facility is built, switching its configuration is likely to **require significant capital investment** and also possibly significant re-design and re-optimisation which could increase technology risk.

2. Juniper's assessment of the viability of applications in Ireland

2.1 We have been assessing the practicality of specific applications for MBT outputs for several years in a wide range of markets internationally. There are some fundamental technical issues (such as the quality and composition of outputs), but there are also 'local' factors (e.g. national policies, supply/demand balance) that may impact upon the viability of specific applications. Figure 3 summarises our assessment of the viability, in an Irish context, of the various outputs identified in Section 1.

2.2 Our analysis shows that **all applications for MBT outputs in Ireland appear to have issues that inherently add risk or uncertainty to individual MBT projects.** Experience elsewhere (notably in the UK) has shown that those issues normally lengthen lead-times because they make contracts more complex, funders require greater Due Diligence and financial closure of projects is more difficult to reach.

2.3 Such delays could be a concern given the pressing timeline for Ireland to meet its landfill diversion targets, especially since some Policy Makers seem to be assuming that MBT can be implemented rapidly. This may not be the case.

2.4 Some of the challenges that we have identified may not be as critical as others, but, if not resolved, they could result in the outputs not finding an outlet and thus being accumulated at the plant or forced into landfill. The rest of this briefing paper is dedicated to discussing these issues in more detail.

Figure 3. Summary of Juniper's assessment of the viability of applications for MBT outputs in Ireland

	Use	Technical challenges	Adequate capacity	Costs	Resource recovery	Regulatory constraints	End-users interest
Solid Recovered Fuel (SRF)	Co-fuel for cement kilns	◆	◆	◆	●	◆	◆
	Co-fuel for direct co-combustion in power plants	✱	✱	◆	●	✱	✱
	Fuel for indirect co-combustion in power plants	◆	✱	✱	●	✱	◆
	Co-fuel for industrial energy requirements	◆	✱	◆	●	✱	◆
	Co-fire in incinerators	●	✱	◆	◆	●	●
	Fuel for dedicated plants	●	✱	✱	◆	●	●
Compost Like Output (CLO)	Spreading on land used for food crops	✱	◆	✱	✱	✱	✱
	Spreading on land used for energy crops	●	✱	●	●	◆	◆
	Spreading on pasture land	✱	●	✱	✱	✱	✱
	Co-spreading with sewage sludge	●	●	◆	◆	✱	◆
	Co-spreading with animal sludge	●	●	◆	✱	✱	◆
	As a compost for horticultural applications	◆	✱	●	◆	◆	✱
	As a compost for use in domestic gardens	◆	✱	●	✱	◆	✱
	As a soil improver for forestry	◆	◆	◆	◆	◆	◆
	On verges & amenity land/ landscaping	●	◆	●	●	◆	◆
	In bogland remediation	◆	◆	●	◆	◆	◆
	On brownfield (contaminated land) sites	●	✱	●	●	◆	◆
Biostabilised output	As landfill cap	●	◆	●	●	◆	●
	Landfill daily cover	●	◆	●	◆	◆	●
	Bio-stabilised output for depositing in landfills	●	●	✱	✱	●	●

✱ potential issue; ◆ uncertain (case-specific, decisions not shaped yet); ● not likely to be an issue

Source: Juniper analysis of inputs from multiple sources

3. Can Ireland find uses for MBT-derived CLO?

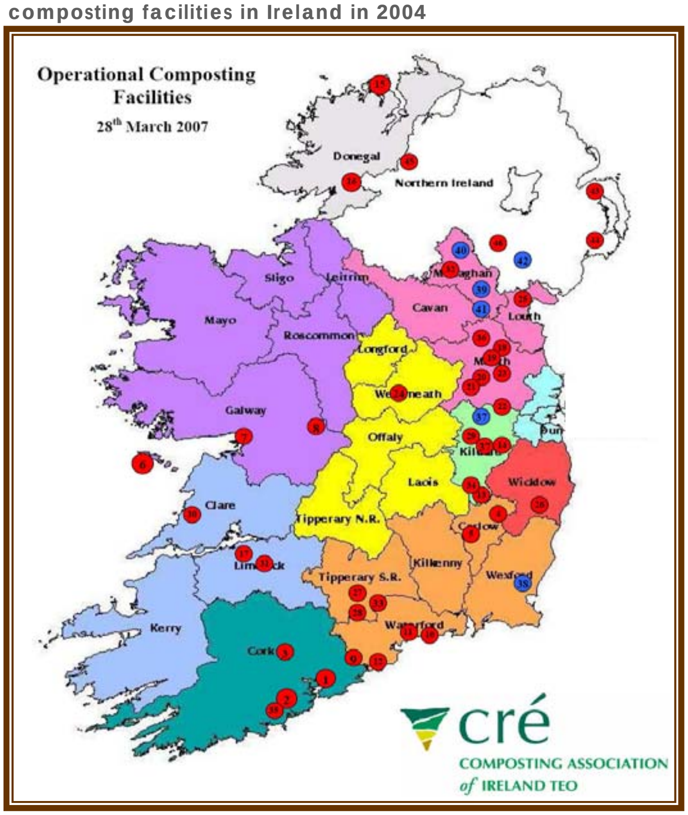
Context

3.1 The National Waste Report[5] indicates that in Ireland about 74% of household and commercial waste is biodegradable[6] with the largest fraction of biodegradable municipal waste (BMW) being paper and cardboard, followed by food and garden waste.

3.2 In terms of tonnage, BMW generation in Ireland was estimated at around 2.2 million tonnes in 2006, from which the largest fraction was landfilled and approximately 38% recycled. To meet EU requirements[7], Ireland will not be allowed to dispose of more than about 1 million tonnes of biodegradable waste in 2010 (that is equivalent to a diversion rate for BMW of about 45%). The National Strategy for Biodegradable Waste, adopted in 2006, set an objective of diverting biodegradable waste from landfill by promoting separate collection, recovery and recycling/composting.

3.3 At present composting of source segregated waste in Ireland takes place at around 40 facilities (see Figure 4).

Figure 4. Location of composting facilities in Ireland in 2004



Note: Blue dots show mushroom composting plants.

Source: Irish Composting Association

[5] National Waste Report 2006, EPA

[6] This number is higher than the UK assumption that about 68% of municipal waste is biodegradable.

[7] Council Directive 1999/31/EC on the landfill of waste

3.4 Total annual composting capacity is approximately 350,000 tonnes with individual facilities ranging in capacity from 500 to 60,000 tonnes per annum. There are predominantly two types of composting plants in Ireland:

- ⇨ facilities that produce 'good quality' compost (from manure, gypsum and straw), which is sold as mushroom compost; and
- ⇨ facilities that compost the organic fraction of household waste.

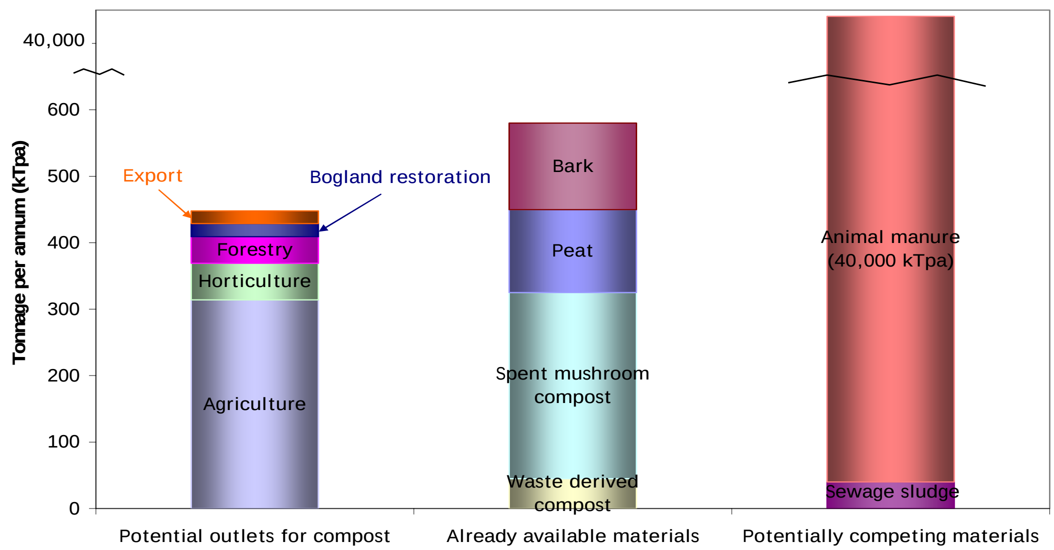
3.5 In 2006, Irish waste composting plants produced about 50,000 tonnes of compost from food and green waste[8]. Landscaping seems to be the main outlet for this compost.[9] Landfill cover, mainly in remediation and capping activities, was the second largest outlet reported.

3.6 To promote the establishment of a sustainable composting sector, the Irish government set up a Market Development Group in 2004. One of the objectives of this group is to stimulate the development of markets for recyclable materials, including waste-derived outputs intended for use as compost.

3.7 **CLO from any new MBT plant of this type planned in Ireland will have to compete in the market against composts derived from source segregated waste and other 'good quality' compost**.

3.8 A report[10] published by the Irish EPA in 2002 suggested that the potential market demand for waste-derived compost in Ireland was about 0.4 million tonnes per annum (see Figure 5), but a more recent report[11] determined that this was too optimistic.

Figure 5. Analysis of current supply and demand in the Irish market



Note: Since this graph reflects the current position, any CLO from new MBT plants would have to displace one of these materials.

Source: Juniper analysis

[8] National Waste Report 2006, EPA

[9] The most recent EPA Factsheet series that was prepared in 2005 estimates that landscaping activities (that include horticulture, gardening substrate, soil enhancement and use as organic fertiliser) accounted for over 55% of the compost produced by Irish waste management plants.

[10] Assessment and evaluation of outlets for compost produced from municipal waste, EPA, 2002

[11] Hitting targets for biodegradable municipal waste: Ten options for change. EPA, 2008

3.9 The 2002 report had estimated that approximately 0.5 million tonnes of organic amendments[12] were being produced annually in Ireland. This is likely to have increased. Those materials alone could saturate the market demand for all compost applications leaving **little opportunity for CLO from MBT plants, which may be seen as inferior products because of its origin.**

3.10 Since CLO originates from mixed waste there is therefore nervousness amongst potential users that it could be contaminated with heavy metals from sources such as batteries; or plastics; or glass and other sharp objects – the presence of any of which can be a significant issue for certain intended applications.

3.11 **Heavy metals and other less visible trace contaminants are of particular concern if there is recurrent spreading on land particularly if it is to be brought into future use in food production because of the possibility of accumulating toxic concentrations over time, even if the concentration level in the CLO is low.** Glass and other sharp contaminants pose a hazard to grazing animals, limiting the potential for use on pastureland.

3.12 In addition to possible contamination issues with CLO, technical challenges may arise where there is a need to meet specific quality criteria for use on land. For example the need to meet ABPR in the UK means that MBT processes need to be configured so that the processing and operational conditions comply with the requirements. This could mean re-design of certain key process elements or the provision of additional equipment at significant cost.

3.13 It is also possible that for land usage of CLO generated from the treatment of MSW in Ireland compliance with the EU Animal By-Products Regulation (EU-ABPR) might need to be sought. The regulations in Ireland about this do not appear to be straightforward, which could impact upon the uptake of this material in this application.

Market capacity …

3.14 There are a wide range of potential applications for CLO (see Figure 1, b). In this section we consider the most pertinent of these and report on the extent to which each could be a solution for Ireland.

3.15 The land allocated to **energy crops** is extremely limited in Ireland. By 2007, only 100 hectares had been planted to cultivate SRCW[13], although there are plans to increase the area of planted energy crops to 10,000 ha by 2010[14]. The Irish EPA notes that:

> *"Current energy-crop utilisation in Ireland is virtually non-existent, with signs of commercial interest only beginning to emerge."* [15]

3.16 **Conclusion: there is little opportunity to use CLO on energy crops**.

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[12] Organic amendments include waste derived compost, spent mushroom compost, peat and bark but do not include 40 million tonnes of manures.

[13] Short-rotation coppice willow

[14] It is worth mentioning that energy crops did not seem to be considered an attractive option in Ireland, following a number of studies that found them to be too expensive (because of the cost of growing the crops) and financially outperformed by forestry residues and wastes.

[15] Energy Crops in Ireland: An Assessment of their Potential Contribution to Sustainable Agriculture, Electricity and Heat Production, Final Report, EPA

3.17 The Irish **forestry** sector, including semi-natural areas, accounts for 14% of land cover (i.e. less than 1 million ha). The EPA assumes in their report[16] that only 10% of land for forestry production is available annually for 'good quality' compost applications and estimated its potential in the market as 40,000 tpa. At this lower level of demand it is unlikely that waste derived material including CLO will be utilised preferentially.

3.18 **Conclusion: scope for use of compost in the forestry sector is limited**.

3.19 Whilst it is proposed that significant quantities of MBT-derived CLO could be used for **brownfield remediation** in the UK, the position in Ireland is different. The recent EPA report[17] stated that

> *"The number of contaminated land sites in Ireland is modest compared to other European countries. In Ireland less than 2,500 industrial sites pose a risk to soil and groundwater, whereas in England and Wales the Environment Agency estimates that there could be as many as 100,000 contaminated sites."*

3.20 **Conclusion: because of the lack of suitable outlets, it is unlikely that there will be significant use of CLO for brownfield remediation in Ireland**.

3.21 We are aware that some companies have been considering using compost materials to remediate industrial **bogland**. The EPA estimated[18] that approximately 50,000 ha bogland require restoration and they go on to estimate that this could provide a potential market for 20,000 tonnes per annum of compost materials. This latter number seems to be low and **there may be scope for greater use of CLO in this application.**

3.22 MBT-derived CLO has found applications in other countries as a soil conditioner and to a more limited extent as compost in **horticultural** and **silvicultural** applications. Unfortunately, at present these applications are either not well developed or already addressed by high quality compost.

3.23 **Conclusion: the market potential for CLO in horticulture and silviculture is limited**.

3.24 **Landspreading** can be a practical, economic outlet in arid regions of the world[19] (e.g. Mediterranean regions). In those areas, this application is capable of absorbing large amounts of MBT-derived CLO. For instance, this management route for MBT outputs has been widely adopted in Spain.

3.25 Ireland's land area is approximately 7 million hectares; about 70% of which is dedicated to agriculture (over 90% being grassland). Therefore in theory, agriculture offers a potentially large outlet for CLO from MBT.

3.26 However, the presence of a large land bank does not, of itself, indicate that there is sufficient capacity available to absorb all of the CLO that might be produced from Irish MBT

[16] Hitting targets for biodegradable municipal waste: Ten options for change. EPA, 2008
[17] Brownfield site redevelopment, EPA, September 2006, p.3
[18] Assessment and evaluation of outlets for compost produced from municipal waste, EPA, 2002
[19] Juniper Consultancy Services, 2005. Mechanical Biological Treatment - A guide for decision makers-Process, Policies and Markets. Available from http://www.wastereports.com/free_downloads/MBT_report.html

plants. We have already referred to the technical challenges associated with landspreading and there are also competitive pressures from slurry and other composts (see Figure 5) as well as regulatory constraints that can limit actual capacity very significantly.

3.27 **In the Irish context, concerns about landspreading CLO are likely to outweigh its benefits in determining the extent of usage.** The EPA's recent report on management options for biodegradable waste[20] identified the following key issues affecting the implementation of landspreading waste-derived compost in Ireland:

- implementation of the ABPR[21] requirements imposes certain restrictions that limit the availability of land on which waste-derived compost can be used;
- The Nitrate Regulations make farmers reluctant to accept additional nutrient loading from off-farm sources;
- regulations on nutrient availability and spreading of sludge will affect the economic attractiveness of landspreading; and
- public opposition to landspreading of treated waste will act as an additional disincentive for widespread adoption.

3.28 Unfortunately, the latest National Waste Report[22] does not provide data on generation of agricultural organic waste (including manure) in Ireland. However, the report published by EPA in 2002 estimated[23] that approximately 40 million tonnes of animal manure require management each year, for which landspreading is the main management option. Manures are usually managed on the same farm where they are produced, and as they have relatively high nitrogen content it is unlikely that there would be opportunities for the application of other organic materials. There is more than sufficient animal manure produced in Ireland to meet demand.

3.29 To establish whether there is capacity for this type of output in the agriculture industry in Ireland, we contacted a number of stakeholders to gauge their interest as well as to understand the current position in relation to compost utilisation. From these discussions we understand that **finding opportunities for landspreading of compost in the agricultural sector in Ireland is already challenging because of competition from animal slurries and sewage sludge**. It seems that securing outlets for even 'good' quality composts is difficult. This suggests that securing opportunities for CLO in this sector would be very challenging.

3.30 **Conclusion: animal manure spreading will limit the opportunities for landspreading CLO**.

3.31 Compared to animal manure, the scale of landspreading of sewage sludge in Ireland appears to be quite small. The latest available estimates suggest that in 2003 approximately 40,000 tonnes of dry solids were produced by the biggest towns and cities in Ireland, of which 63% (25,000 tonnes) was spread on agricultural land as fertiliser.[24] The Irish wastewater

[20] Hitting targets for biodegradable municipal waste: Ten options for change. EPA, 2008

[21] EU Animal By-products Regulations is implemented in Ireland through S.I. No.707 of 2005 European Communities (Animal By-products) (Amendment) Regulations 2005; S.I. No. 248 of 2003 European Communities (Animal By-products) Regulations 2003.

[22] National Waste Report 2006, EPA

[23] Assessment and evaluation of outlets for compost produced from municipal waste, EPA, 2002

[24] DEHLG, http://www.environ.ie/en/Environment/Water/WaterServices/SludgeManagement

companies want to maintain this as a long-term disposal route since it is a relatively low cost option.

3.32 Commentators in the water treatment industry suggest that sewage sludge production in Ireland will continue to increase, mainly due to changes in EU and national water legislation. Given that there are constraints on landfilling, and since there are no thermal outlets for this material in Ireland, the quantity of sludge seeking landspreading opportunities in agriculture will increase.

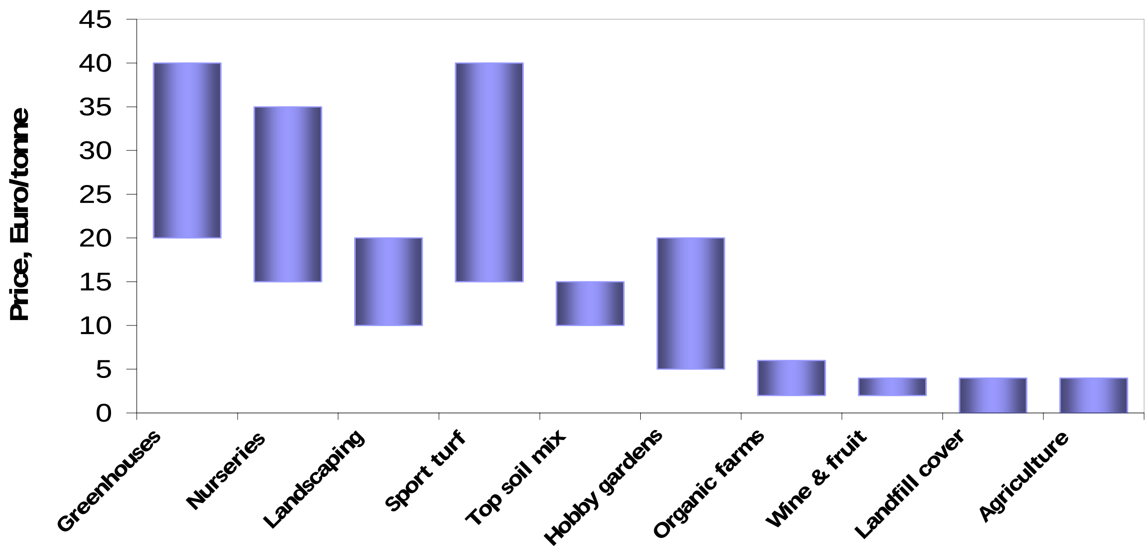
3.33 **Conclusion: sewage sludge will compete with CLO for the limited landspreading capacity in Ireland**.

Costs...

3.34 In general, when a good quality compost is used the buyer pays for the material. But when CLO is made from mixed waste, the user is paid to take the material.

3.35 In countries with established composting markets, there are a range of **sales prices** for compost depending upon the application (see Figure 6). However, it is incorrect to assume that CLO from the Irish MBT plants should fall somewhere within this price range.

Figure 6. Prices for compost in different compost markets



Source: European Compost Network (ECN), 2007

3.36 In Ireland, the price for 'organic amendments' is reported to range widely from about €10/m^3 for wholesale material to €100/m^3 for retailed material.[25]

3.37 From our discussions with Irish stakeholders we understand that the traditional compost industry is very protective of their existing markets.

3.38 If CLO can find outlets in land applications in Ireland, we expect that this would have to be on a fee-paid basis (i.e. the operators of MBT plants would have to pay the end-users to take their outputs), similar to that paid by Irish water utilities for spreading sewage sludge on land.

[25] Assessment and evaluation of outlets for compost produced from municipal waste, EPA, 2002

3.39 However, paying end-users to take CLO is a viable option because it avoids higher disposal costs, minimising overall waste disposal costs.

3.40 **Conclusion: the potentially high charges for landspreading are not a 'stopper' – the issue is the amount of land that may be accessible.**

Regulatory constraints …

3.41 There are no direct constraints on utilisation of compost but there are a number of regulations that have an indirect impact.

3.42 The proposed **Directive on Biowaste**[26] (that was expected to bring clarity in helping EU countries meet landfill diversion targets) appears to have been abandoned and it remains unclear when the **EU Soil Framework Directive** will be accepted. Without either, the EU has not yet established the principles under which waste-derived materials can be spread on land.[27]

3.43 Nevertheless, there are several EU Directives that have a direct impact on the application of organic materials to land – including the use of CLO from MBT plants.

3.44 **The Water Framework Directive** 2000/60/EC aims to protect waters from pollution from diffuse sources. A long list of priority chemicals (that could be present in CLO) may have to be monitored and controlled. This will act as a general disincentive on the spreading of CLO near watercourses (water quality is currently a major concern in Ireland since the outbreak of cryptosporidiosis in Galway in March 2007).

3.45 **The Nitrates Directive** 91/676/EEC impacts upon the application of waste derived compost on arable land by restricting the amount of nitrate applied in nitrate vulnerable zones, and thus also limiting the amount of compost or manure that can be applied annually per hectare of land. In practice this will not only constrain the amount of CLO that can be spread but will also increase competition from manure and sewage sludge for available land.

3.46 **The Animal By-Product Regulations**[28] sets requirements that control the application of materials that can contain pathogens. This requires MBT processes to be modified (at a cost) to ensure complete pasteurisation. The ABPR compliance would be an issue for all MBT plants in Ireland producing material for land application.

3.47 The **waste management (licensing) requirements**[29] may also constrain or slow-up the development of this type of application. We understand that, so far, a precedent has not yet been established for the application of MBT derived CLO on land as no project has yet gained EPA approval in Ireland.

3.48 Apart from regulatory concerns related to CLO, in some countries there are also regulatory constraints in terms of operation of MBT plants. For example, in Germany, the strict

[26] The proposed EU Biowaste Directive was supposed to establish common framework to soil protection. The proposal provided for the restrictions on application of certain classes of compost. According to this proposal, stabilised biowaste may have only been used on land that is not used for food production, e.g. landfill engineering.

[27] It was reported that the EU Council could not reach an agreement on the proposal at their meeting in December 2007.

[28] Regulation (EC) No 1774/2002 that is transposed into Irish legislation via S.I.612 of 2006 (European Communities (Transmissable Spongiform Encephatopathies and Animal By-Products) Regulations 2006.

[29] S.I. No 395 of 2004, Waste Management (Licensing) Regulations 2004. Available from http://www.epa.ie/downloads/legislation/waste/licensing/name,13658,en.html

emissions control requirements force MBT plants to use thermal oxidisers for treatment of exhaust gases. This method of gas cleaning can be expensive (in both capital and on-going maintenance)[30] and also means that the facility will require a moderate size chimney, which may engender concerns in the local community.

3.49 Currently, there are no standards on emission control from MBT plants in Ireland. However, if the Irish Government decides to regulate the environmental impact from MBT plants this will affect the attractiveness of this waste management option and may require retrofitting of existing plants.

End-user interest…

3.50 Experience in other countries has shown that farmers may show an interest in accepting CLO as a soil improver if they are paid to take the material. Recent negative press coverage does not help. For example, a farmers association in Scotland (Quality Meat Scotland) recently placed a ban on the use of waste derived compost,

> *"until key answers can be provided to legitimate questions on human and animal health"*.[31]

3.51 We found **no evidence of a strong market appetite in Ireland for the use of MBT-derived CLO in any market**. The potential end-users in the higher quality compost markets are protective of their image and indicated that they do not want to be associated with compost derived from mixed waste. They have a strong negative perception about CLO as it is, in their opinion, a potential source of **pathogens**[32] for food crops.

3.52 Some applications are less sensitive to the quality of the material. We understand that **the Irish construction industry and the forestry sector may be interested in accepting this type of MBT output, provided that they are paid a fee** for taking this material.

3.53 Currently, **there are no regulatory drivers in Ireland to promote the development of a composting market**. The development of a national compost standard and quality assurance scheme is identified as one of the key deliverables of the Organics Programme[33]. Research to develop a national standard for compost is being funded by the EPA. The indicative deadline for development of both the standard and quality assurance scheme is December 2008.

3.54 The Market Development Group (MDG) identified a number of barriers for the development of markets for all types of compost materials[34]:

- ⇨ *lack of a national compost standard;*
- ⇨ *limited information on potential customers that could potentially benefit from compost utilisation;*

[30] See also Operation experiences and potential for optimisation of regenerative thermal oxidation plants in the field of MBT, Olaf Neese, et al. Proceedings of International Symposium MBT 2007.

[31] The Ends report January 2008, page 18.

[32] Any collection or culture of organisms which may cause a disease in humans or animals.

[33] The Organics Programme is one of the directions of work of the Market Development Group (MDG) hat was set up in 2004 with an objective of stimulating the development of markets for recyclable materials in Ireland. The Organics Programme covers one of the three main waste streams prioritised for market development (the other two are plastics and paper).

[34] Market Development Programme for Waste Resources 2007-2011

- *no clear definition of the point at which compost/ digestate derived from waste becomes a product and ceases to be a waste;*
- *lack of education and public perception/awareness about waste derived materials; and*
- *implications of the Nitrates Directive and Soil Strategy*.

These barriers are also relevant to the development of a market for CLO.

Summary…

3.55 **In principle, there is enough land in Ireland to consume all the CLO that can be produced if MBT were to be used to treat all of Ireland's waste. However, in practice, regulatory constraints, competition from manure and sewage sludge and the negative market image of CLO are all likely to impact significantly upon demand**.

3.56 **In our opinion, there is insufficient evidence of demand for CLO to rely on this outlet to underpin the development of an MBT-led approach to meeting Ireland's diversion targets.**

4. Can the Irish market absorb fuel outputs from MBT?

4.1 In Juniper's 2005 report on MBT[35], we emphasised that producing a solid-recovered fuel (SRF) that had properties that met market expectations was critical. That study identified various key parameters that determined fuel quality and analysed their impact on the suitability of SRF as an alternative fuel for a range of industrial applications. Since that report, **there has been mounting evidence that MBT plants that do not have stable off-take contracts for SRF face serious challenges in finding spot market outlets**. Moreover, private sector project finance is difficult to secure without such off-take contracts.

4.2 Although some sectors could use SRF[36] as an energy source, there is relatively little incentive to do so. We understand that, at present, there are no major economic drivers in Ireland to stimulate use of SRF for power production as there are, for example, in Italy and the UK. The 'Renewable Energy Feed In Tariff' (ReFIT), that was introduced by the Irish Government in 2006 to support renewable electricity projects, does not appear to include MBT derived fuels. Therefore, **management of MBT-derived fuels is most likely to be a net cost to the MBT plant rather than a source of revenues.** This cost for MBT operators may be high because of the fee that they would have to pay to the cement companies, incinerators and dedicated plants in order to take the SRF.

4.3 If electricity produced from waste derived fuels were classified as renewable energy, SRF could play a role[37] in meeting the 15% target of Ireland's gross electricity consumption from

[35] Juniper Consultancy Services, 2005. Mechanical Biological Treatment - A guide for decision makers- Process, Policies and Markets. Available from http://www.wastereports.com/free_downloads/MBT_report.html

[36] The discussion in this section relates to the biomass rich fuel fraction. The plastic rich fraction produced by most MBT processes would also have to find an outlet or otherwise be landfilled.

[37] To the extent that SRF contains biogenic material. 50-70% of the household waste would normally be regarded as biogenic. MBT process companies claim different percentages of recovery (60 – 90+%).

renewable sources to be achieved by 2010 (the share of renewable energy in Ireland is currently 8.6% of gross electricity consumption).

4.4 It is now widely recognised that **the technical challenges, economic factors and regulatory constraints associated with MBT fuel outputs makes finding viable outlets not straightforward**. When combined with issues related to competition from other waste-derived or biomass fuels, the supply/demand balance and the relative lack of enthusiasm for MSW derived fuels from end-users, the issue can become a critical constraint on the take-up of biodrying and related fuel variants of MBT and MHT – as has been seen in the UK over the last five years. In the section that follows, these factors are discussed in the context of the situation in Ireland.

Where can SRF be used in Ireland?

4.5 As far as we are aware, there is no precedent for the utilisation of MBT-derived fuel in Ireland.

4.6 Research that was conducted by Juniper in 2005[38] indicated a reasonable level of interest in using this type of fuel amongst **cement kiln** operators in Ireland.[39] Other recent studies[40] have indicated that there is also some interest in the **power industry** for fuel outputs. At face value, this seems a rather positive situation.

4.7 Moreover, fuel outputs from MBT may also be utilisable as a co-fuel in waste **incinerators**. Although Ireland does not yet have any municipal solid waste incineration capacity, there are well known and relatively advanced plans for at least three plants that together would add significant waste processing capacity. We therefore included these in our analysis.

4.8 MBT fuel outputs could be used in dedicated facilities (**gasifiers**, **fluidised bed combustors** or other types of plant built specifically to handle SRF – either on the same site as an MBT facility or as a regional facility servicing several MBT plants). No such plants exist though there are plans for at least one plant. Because of the long lead time associated with this type of project, new infrastructure is not likely to have a significant impact in the short-to-medium term.

4.9 Manufacturing industry uses significant amounts of energy, with part of it generated on-site in **industrial boilers**. These boilers represent another potential outlet for MBT fuel outputs.

4.10 From our experience in the sector, it is clear that **at first, end-users tend to be enthusiastic about using waste-derived fuels** because they represent a cheap fuel option which is available locally and abundant. **But**, they frequently **lose interest soon after learning about the technical and regulatory challenges associated with burning waste-derived fuels**. Nervousness about public perceptions and the possible damage to their corporate image by being seen to burn wastes exacerbates this issue.

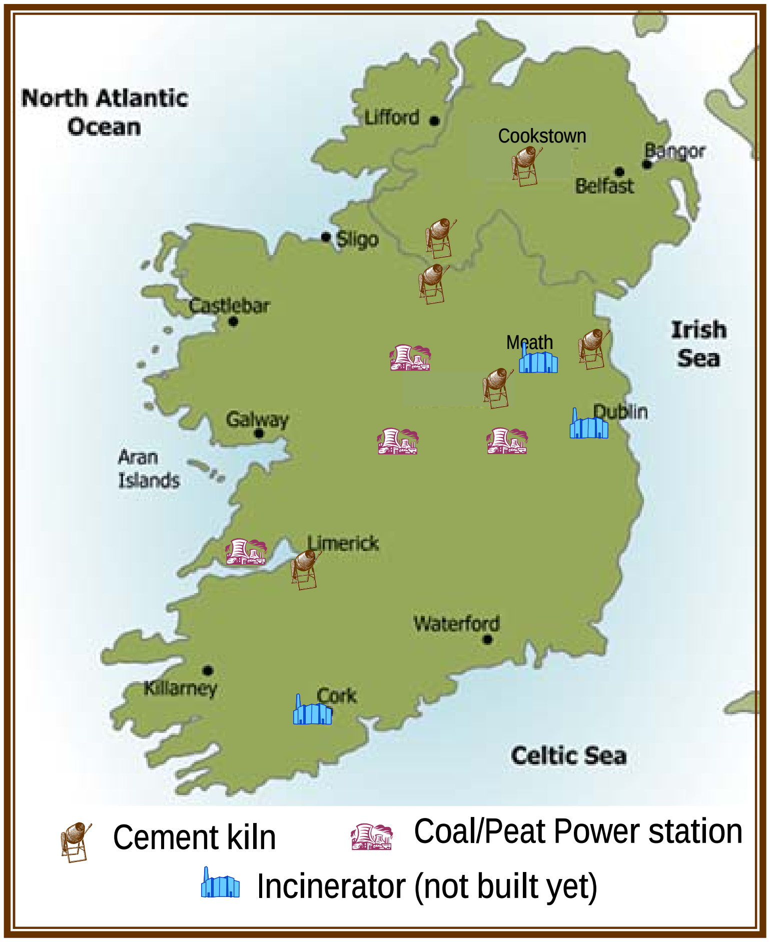
4.11 Figure 7 identifies the main potential cement kilns and coal/peat-fired power plants, as well as the proposed incinerators, which together are the most significant potential users.

[38] Analysis of the potential take-up of alternative fuels in the Irish cement industry, Juniper, 2005

[39] It should be noted that SRF and RDF have been used interchangeably by various cement kiln operators.

[40] Meeting Ireland's Waste Targets: The Role for MBT, Eunomia, 2008

Figure 7. Location of existing and planned fuel utilisation infrastructure in Ireland



Source: Juniper analysis

Potential SRF generation in Ireland

4.12 According to the recent National Waste Report 2006[41], Ireland generates approximately 3.4 million tonnes of municipal waste annually. Since plans for waste management infrastructure in Ireland have not been finalised yet, it is not possible to know with certainty how much SRF will be produced in Ireland. A scenario based on high recycling rates (which is the government's aspiration) and significant investment in MBT-to-SRF plants has been evaluated by Juniper. **If 50% of Ireland's municipal waste was recycled and the rest was processed by MBT plants of the bio-drying type, then from 600 to 850 kTpa of SRF[42] would require an end-use outlet**. If other types of MBT were more popular, then clearly the quantity of SRF requiring an outlet would be lower.

[41] National Waste Report 2006, EPA

[42] The range reflects differences in yields of SRF from particular MBT processes (i.e. an observed range of 35 to 50% of the input waste treated in MBT plants of the bio-drying type).

Usage of SRF in Cement Kilns

4.13 There are a number of reasons why cement kilns are a particularly attractive solution to recovering the energy value from SRF, however, there are also significant issues that can constrain takeup.

4.14 **Restrictions on the levels of contamination:** The **operating conditions in cement kilns can be synergistic with handling a fuel that has some contamination**. The alkaline conditions in the kiln are known to suppress certain acidic contaminants and the high operating temperature (typically > 1500^{0}C) produces a clinker product in which contaminants such as heavy metals are effectively immobilised in such a way that the potential for leaching from the final cement product is thought to be negligible.

4.15 However, **cement kiln operators do place restrictions on the quality of SRF they will take**. In many cases these restrictions relate to particle size, levels of chlorine and ash content. The limit on particle size is normally because of the size reduction and fuel blending that are usually required before the injection of alternative fuels into most modern kiln designs. Limits on the ash content of the final cement product, mean that this component of the fuel feed is also tightly controlled. Experience indicates that consistently producing an acceptable quality SRF can be difficult for some types of MBT processes.

4.16 An earlier study conducted by Juniper on the use of alternative fuels in the Irish cement industry[43], indicated that **chlorine was regarded as a major consideration for the use of alternative fuels.** High levels of chlorine in input materials increase the formation of alkaline chlorides (and other metal chlorides), which cause 'slag' build-up in the process. This not only impairs the performance of downstream electrostatic precipitators (and so increase dust emissions), but can also result in blockages in pre-heater towers, both of which can result in significant plant downtime. SRF can contain from 5 to 130 times more chlorine than bituminous coal and this factor alone is likely to have implications for the maximum amount of SRF that can be co-blended.

4.17 Such limits on chlorine concentration are not always easy to achieve, as a number of recent projects in the UK have found. For example, limiting the quantity of chlorine-containing plastics in SRF is counter-productive to how bio-drying processes are designed to be operated i.e. to keep CV-rich materials such as plastics in the fuel output. Also limiting the amount of ash may be challenging as this component derives from a wide range of materials (including paper, card, textiles and plastics) the proportions of which are not easily controlled in the MBT plant.

4.18 Thus, **there may be technical challenges in producing a suitable quality SRF for use in cement kilns**.

4.19 **Regulatory Constraints:** Cement kilns, if they burn waste, will fall under the EU-WID requirements. However, their emissions are calculated and normalised differently than those from an incinerator. In our experience, **the combustion of reasonable levels of SRF in cement kilns might not impose additional major constraints from a regulatory perspective**.

[43] Juniper, 2005. Analysis of the potential take-up of Alternative Fuels in the Irish Cement Industry. Client report, 44 pp.

4.20 The fact that the plant falls under EU-WID may however cause concerns in the local community or engender opposition from environmental NGOs; addressing which can become a significant issue for the plant's management, which may, in turn, lessen their enthusiasm for accepting SRF.

4.21 **Gate fees for processing SRF:** Cement kiln operators can command **significant gate fees** for taking SRF. This is currently the main attraction for using this material as a co-fuel as its CV is relatively low compared to other waste fuels traditionally used in this industry. Gate fee numbers vary, depending on the country market situation and the type of co-fuel, but for SRF numbers in the public domain for other countries range from about €50 to €70 per tonne.

4.22 **Available capacity for SRF**: The total cement production capacity in Ireland is approximately 5.5 million tonnes per annum. Figure 8 lists the existing cement kilns in Ireland, and Figure 9 provides relevant information about the possible energy requirements at these plants.

Figure 8: Cement kiln types and technical characteristics

Local Company / Brand	Parent / Group	Site Name / Location	Year of Start-up	Kiln Type	Technical Characteristics
Blue Circle	Lafarge	Cookstown	1968	Semi-dry	"Lepol"– travelling grate pre-heater
Irish Cement	CRH	Platin 1[1]	1972	Dry	Long dry kiln
		Platin 2	1977	Dry	4 stage cyclone pre-heater
		Limerick	1983	Dry	4 stage cyclone pre-heater
Quinn Cement	Quinn Group	Derrylin[2]	1989	Dry	4 stage cyclone pre-heater
		Ballyconnell	2000	Dry	Pre-calciner with separate combustion chamber
Lagan Cement	Lagan Group	Killaskillen	2002	Dry	Pre-calciner with separate combustion chamber

1. A new cement kiln with a capacity of 1,300 kTpa is expected to be operational in 2009.
2. Derrylin was mothballed in 2000, but a major retrofit was commenced in 2003 and the plant returned to commercial operation in November 2004.

Source: Juniper analysis, 2005

Figure 9: Estimated annual energy requirement of the Irish cement industry

Kiln	Total Capacity / Output (kTpa)		Estimated Energy Requirement (GJpa)	
	2005	2007	2005[1]	2007[1]
Cookstown	500	500	1,950,000	1,950,000
Platin 1	400	400 (1,300[2])	1,900,000	1,900,000
Platin 2	1000	1,200	3,650,000	4,380,000
Limerick	800	950	2,920,000	3,467,500
Derrylin	500	500	1,825,000	1,825,000
Ballyconnell	1,300	1,300	3,900,000	3,900,000
Killaskillen	600	700	1,800,000	2,100,000
Total	5,100	5,550	17,945,000	19,522,500

1. Energy requirements have been calculated by Juniper based on typical performance of representative plants around the world
2. A new cement kiln with a capacity of 1,300 kTpa will replace Platin 1

Source: Industry interviews (2005 & 2008); GC's Global Cement Directory 2006-2007; Juniper analysis

Figure 10: Potential use of alternative fuels in Irish cement kilns (kTpa)

Kiln	RLF[1]	Whole Tyres	Tyre Shreds	RFO[2]	RDF[3] / SRF[4]	MBM[5]	Profuel[6]	Dried Sewage Sludge
Cookstown	✓✓✓✓[7]	✓✓✓✓		✓				
Platin 1	✓		✓		✓	✓	✓	✓
Platin 2	✓		✓		✓	✓	✓	✓
Limerick	✓		✓		✓	✓	✓	✓
Derrylin					✓			
Ballyconnell					✓			
Killaskillen			✓✓		✓✓	✓✓✓✓		✓✓

✓✓✓✓ **Commercial use** ✓✓✓ **Current or previous trial** ✓✓ **Plans publicly announced** ✓ **Actively considering**

1. Recycled Liquid Fuel
2. Recycled Fuel Oil
3. Refuse Derived Fuel (from Municipal Solid Waste)
4. Solid Recovered Fuel (from Municipal Solid Waste)
5. Meat and Bone Meal
6. A mix of plastics, paper and textiles derived from industrial wastes
7. We understand that RLF is no longer used but the plant is considering upgrading emissions control to accommodate this fuel.

Source: Based on Juniper interviews with cement kiln operators, 2005; updated 2008

4.23 The cement industry in Ireland currently satisfies most of its energy needs with coal and petroleum coke (petcoke). However, whole tyres, **M**eat and **B**one **M**eal (**MBM**) and **R**ecovered **L**iquid **F**uel[44] (**RLF)** are being used as substitute fuels in some cement kilns and some other waste derived fuels are being considered (see Figure 10).

4.24 There is a limit to the quantity of an alternative fuel that can be co-fed in cement kilns. This limit is set by a number of parameters which includes: the energy density and physical characteristics of the fuel, the type and concentration of contaminants and the type of kiln, the mode of feed (direct injection, via a pre-calciner, blended solids, etc.). In practice, the scope for optimising co-fuel blends makes the range of viable permutations very considerable. The assumptions we have used (see Figure 11, Note 2) about the level of fuel replacement for each of the different fuel type are based on data published in the literature and our understanding from conversations with cement kiln operators using similar alternative fuels.

4.25 In 2006, c. 17% of the fuel requirements of the cement industry in Europe were met by alternative fuels[45]. Although many countries have achieved large rates of fuel substitution (Germany has a 49% substitution rate), Ireland's substitution rate is more likely to be nearer to the European average at least in the short term since Irish cement kilns may have to invest in new equipment to increase their substitution rate.

4.26 Our 2005 study found that the potential amount of SRF that could be produced is greater than the ability of the Irish cement industry to absorb the material. Figure 11 shows our recently updated supply/demand analysis. The results of this updated analysis show that the amount of SRF that could be produced in Ireland far exceeds the theoretical maximum demand from cement kilns, assuming that Ireland selected the MBT-to-fuel option for all its new infrastructure. But if relatively few biodrying plants are built or other outlets (such as power plants) are available, then the supply/demand balance could be acceptable. However, in this circumstance other solutions for meeting Ireland's diversion targets would be needed.

Figure 11. Supply/demand balance for alternative fuels in the Irish cement industry

Fuel	Potentially available (ktpa)[1]	Theoretical potential uptake (ktpa)[2]
RLF	48 - 143	51 - 203
Scrap tyres	40 - 70	62 - 124
Meat & bone	47 - 150	103 - 206
Waste plastics	20 - 260	45 - 90
SRF	0 - 850[3]	65 - 195

1. Numbers are calculated using the EPA's statistics and Juniper estimates
2. Based on the following substitution rate ranges: solvents between 10 and 40%, used tyres between 10 and 20%, meat and bone between 10 and 45%, plastics between 10 and 20%, and SRF between 5 and 15%. It should be noted that assumptions are made on a semi-cumulative basis: if cement kilns use one type of alternative fuel, they have to eliminate the others to some extent.
3. This number includes SRF that can be produced in Ireland from MSW. It does not take into account the amount of SRF that might be produced from industrial and commercial waste and which would place additional pressure on processing infrastructure.

Source: Juniper analysis

[44] Mainly solvents, these materials have high calorific value, but also high levels of chlorine content
[45] Activity Report 2006, CEMBUREAU.

4.27 Some capacity is already committed to competing waste-derived fuels. Take-up of more attractive fuels could further constrain the available capacity. For example, Lagan Cement has already announced its intention to substitute part of its fossil fuel requirement with up to 30 kTpa of RDF[46] and 10 kTpa of tyre chips.

4.28 **Conclusion: while there is potential for using SRF in Irish cement kilns, there are issues that policy makers should be aware of. There are also constraints on the amount that could be used at each plant.**

Utilisation of SRF in Power Plants

4.29 It is estimated that 34% of the electricity generated in Ireland comes from coal and peat[47]. The remainder of Ireland's energy generation is from sources (gas, wind) that are not compatible with a co-fuelling approach using SRF. For this reason, this section is focused on co-fuelling opportunities with coal or peat.

4.30 In the power utility industry, SRF could be used either in direct co-combustion with coal/peat or gasified in a separate plant and the syngas fed to the existing fossil fuel fired boiler.

4.31 **In the direct co-combustion configuration**, the SRF needs to be prepared and blended with coal/peat. **There are significant technical challenges** associated with this. Blending is not straightforward and this aspect of using waste derived fuels such as SRF is known to have damaged mills leading to a significant risk of fire or even explosion. Fuel injection systems can become blocked, resulting in extremely expensive downtime for the power plant.

4.32 Additionally, the attractiveness of using SRF as a co-fuel in this application is also affected by the following factors:

- Contamination of ash with heavy metals present in the SRF, which could affect existing markets for pulverised fly ash (PFA) (about 50% of coal flyash is used by the construction/aggregates sector).
- Dust and odour emissions related to SRF handling and storage;
- Corrosion from chlorine in the waste – resulting in greater downtime and higher maintenance costs;
- Slagging and fouling of the boiler due to the alkali metals in SRF;
- Erosion of heat transfer tubes by abrasive materials in the SRF;
- The need to ensure WID compliance may limit the percentage of waste in the fuel blend to avoid very expensive upgrading and may adversely impact on the performance of existing Flue Gas Desulphurisation (FGD) process. Higher levels of emissions monitoring and regulatory reporting will be required if SRF is co-combusted.
- Potential damage to community relations or protest activity by environmental NGOs because the plant is combusting wastes.

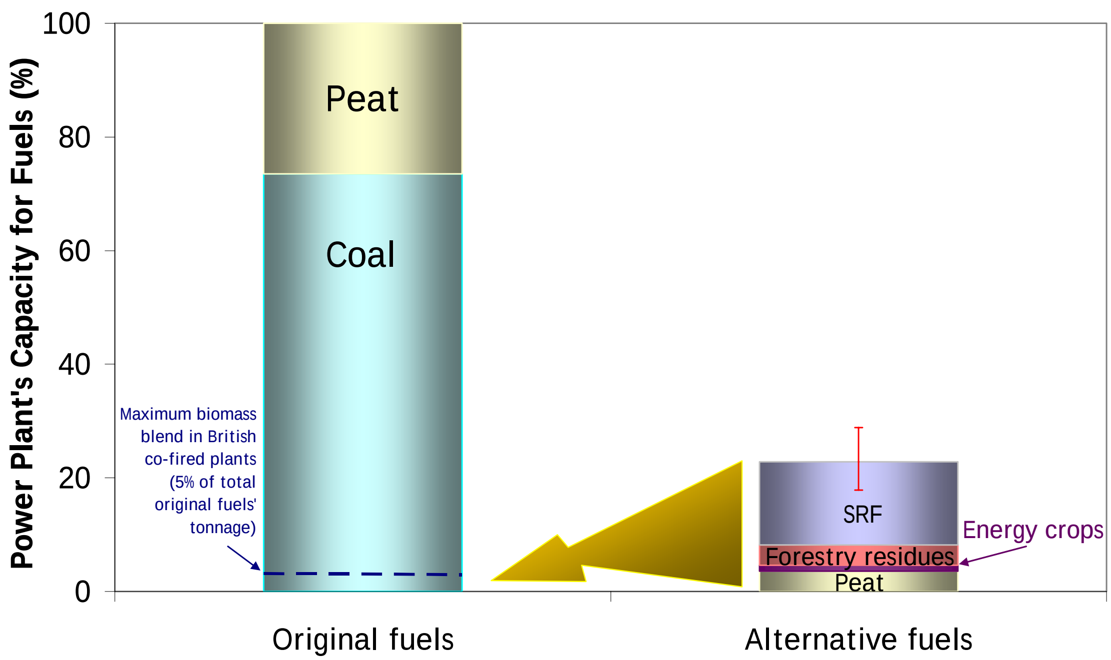
[46] Although Lagan Cement refers to this fraction as SRF, it is classified by Juniper as RDF since it is a plastic-rich fraction that is separated before composting takes place.

[47] Renewable Energy in Ireland, 2007 update, Sustainable Energy Ireland.

4.33 We are aware that in the UK, biomass co-firing does not typically exceed 5%[48] but because of the potential higher levels of contamination in SRF compared with virgin biomass feedstock, we anticipate that a smaller percentage of SRF would be co-fired with coal. For this reason the maximum amount of SRF that could be direct co-fired in power plants in Ireland (assuming all of the significant challenges identified above could be addressed) is c.150 kTpa, which is small in the context of the amount of SRF that could be produced.

4.34 Figure 12 compares the potential energy (thermal load) that could be produced from alternative fuels with that currently being generated from coal and peat. In this context, SRF would only displace 10 to 20% of Ireland's current dependency on coal and peat.

Figure 12. Analysis of the capacity in the Irish power industry to accept SRF from MBT plants



Source: Juniper analysis

4.35 **Conclusion: There are significant issues associated with direct combustion of SRF in power plants.**

4.36 **The indirect co-combustion configuration** has advantages over direct co-combustion in that SRF is managed via a separate pre-process, thereby circumventing some, but not all, of the issues identified above. (This approach uses a gasifier to convert the SRF into a gaseous fuel that is then injected into the utility boiler.)

4.37 However, this approach has its own challenges, which include:

- Technical risks associated with relatively unproven waste gasification technology;
- Process integration risks;
- Relatively high investment cost.

[48] In Figure 12 the dashed line is drawn at 3%. The reason is that 5% in tonnage of SRF represents 3% in energy value because SRF as a lower calorific value than coal.

4.38 There are few reference projects of this type worldwide and for this configuration to be seriously considered, there need to be significant economic incentives.

4.39 **Conclusion: we do not expect indirect co-combustion to play a significant role in the Irish market.**

Use of SRF in other faciities

4.40 **Co-fueling in industrial boilers:** Many sites (such as hospitals, shopping malls and leisure centres) have large heat loads; manufacturing sites require process steam, heat or electricity. **In the context of lessening dependence on fossil fuels and reducing carbon footprint, SRF can be an attractive potential fuel for those facilities' boilers**.

4.41 However, there are similar **technical and regulatory challenges** in utilising SRF in industrial applications to those already described in relation to direct combustion in coal-fired plants, which very significantly lessen the attractiveness of SRF.

4.42 Because of the widely varying requirements of such applications it is difficult to generalise about the extent to which these challenges would be a 'stopper' for specific projects.

4.43 There are relatively few examples of such applications elsewhere in Europe, but there is growing interest. For example, one UK-based chemical company plans to use relatively large quantities of MBT-derived SRF to meet its own energy demands. In this application the SRF is to be utilised in a dedicated CHP plant.

4.44 **Conclusion: there is some scope for using SRF in industrial boilers but, given the nature of Ireland's manufacturing infrastructure, such applications may be somewhat limited.**

4.45 **Use as co-fuel in incinerators:** currently in Ireland there are no operational incinerators for municipal or industrial waste. There are 11 small-scale units within manufacturing sites that mainly process pharmaceutical and chemical waste generated on-site. The Irish EPA estimated that in 2006, c. 125,000 tonnes of industrial waste (including c. 80,000 tonnes of hazardous waste) were incinerated in the country.[49]

4.46 The proposed incineration plant for Dublin (Poolbeg) that received planning approval to treat up to 600,000 tonnes of waste is not expected to be operational until 2011. Planning permission was granted for two facilities in Ringaskiddy, in County Cork and Carranstown, in County Meath, designed to process 200,000 tonnes of waste per annum each.

4.47 Since SRF has a higher **CV** (**C**alorific **V**alue) than MSW, **there are limits to the amount of SRF that can be co-fed**. This limit can be raised if water-cooled grates are specified when the plant is built, but these are more costly than air-cooled grates.

4.48 Co-combustion of SRF in incinerators or combustion/gasification in dedicated plants is not associated with additional regulatory complications, since all such plants will be subject to the Integrated Pollution Prevention Control (IPPC)[50] regime and the EU Waste Incineration Directive (WID)[51].

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[49] National Waste Report 2006, EPA

[50] IPPC is a regulatory regime aimed to control pollution from certain industrial activities following the requirements of Directive 96/61/EC on Integrated Pollution Prevention and Control ("IPPC Directive"),

[51] Directive 2000/76/EC on the Incineration of Waste sets a range of regulatory and technical requirements that include permitting, operating conditions, emission limit values and monitoring requirements, etc.

4.49 **Experience elsewhere in Europe indicates that combustion or gasification of SRF within a dedicated facility is a relatively expensive option** but, since landfill is relatively expensive in Ireland, they may be relatively more attractive options than in some other countries. We understand that the indicative gate fee for the proposed commercial MSW incinerators is in the range €90-110 per tonne and we feel that this can be used as an initial guide cost for assessing incineration capacity using SRF.

4.50 **Conclusion: Co-incineration, gasification or combustion in dedicated plants are interesting options for managing SRF.**

5. Can MBT-treated outputs be landfilled in Ireland?

5.1 Ireland has **no regulation that prevents the landfilling of MBT outputs**.

5.2 Therefore there are a number of further key questions that need to be considered in assessing whether this application for MBT outputs is viable in Ireland:

- Is there a political will for landfilling MBT outputs?
- How do policy makers address concerns that landfilling of bio-fraction is not consistent with the principles of maximising resource recovery?
- Is there sufficient void space in Ireland to support sending MBT outputs to landfill?
- Are there any significant technical challenges?
- Would incineration still be required?
- How costly is this approach?
- Will landfilling MBT outputs help Ireland to achieve its EU landfill diversion targets?

5.3 Our analysis indicates that **some of these are not an issue while others are significant potential areas of concern** (as discussed below). In our opinion these concerns need to receive greater consideration before Government embarks on this route.

Political drivers ...

5.4 The 'Programme for Government' issued in 2007[52] places strong emphasis on the introduction of MBT facilities as a solution to meeting the country's EU landfill diversion targets. Aspirational targets set out by the Irish government suggest a desire for significantly less landfilling (an increase of over 50% of all waste arisings compared with current rates) alongside the stated aims that they will:

> *"ensure that the landfills currently provided for under regional waste management plans should be the last to be constructed for a generation".*

5.5 Such aspirations suggest that landfilling MBT outputs is inconsistent with the overall objectives of maximising resource recovery and minimising dependence on landfills. Yet, there have been strong representations from both within the new National Government and

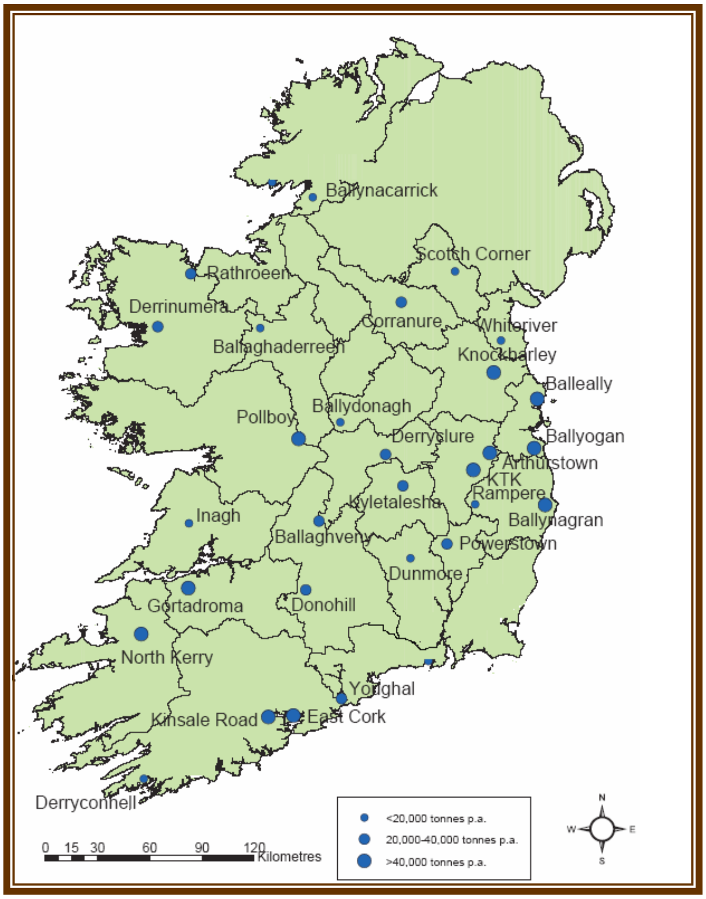
[52] Ahern, B., Sargent, T., Harney, M., 2007. An Agreed Programme for Government. www.taoiseach.gov.ie/attached_files/Pdf%20files/NewProgrammeForGovermentJune2007.pdf (last accessed on 5 October 2007).

from within the industry and its advisers[53] that the bio-stabilisation variant of MBT is the way to deliver Ireland's diversion targets.

Availability of void space…

5.6 Landfill is currently the most common disposal route in Ireland for residual waste. Figure 13 shows the location and capacity of the operational landfill sites in Ireland in 2004.[54] Our research has indicated that the majority of these sites are still operational.

Figure 13. Location and scale of municipal landfills in Ireland[55]



Source: Adapted from State of the Environment Report, 2004

5.7 In 2006, approximately 2 million tonnes of municipal waste was being sent to 29 landfill sites. According to the National Waste Report, Ireland has

> *"sufficient landfill capacity to operate for many years to come."* [56]

[53] Meeting Ireland's Waste Targets: The Role for MBT, prepared for Greenstar by Eunomia, 2008

[54] State of the Environment Report, EPA, 2004

[55] New sites that are not shown on the map include East Galway/Connaught, Bottlehill/Cork, and two landfills in Kildare – Drehid and Kerdiffstown.

[56] National Waste Report 2006, EPA

5.8 A report prepared by CEWEP[57] in that same year concluded that the national annual landfill capacity is about 4 million tonnes.

5.9 A recent report[58] citing data from "Annual Environmental Returns" [sic] has indicated that the currently available landfill void space in Ireland is equivalent to 24 million tonnes. We also understand a number of new sites are planned for the next few years which could increase the total available void space in the short-term to 36.5 million tonnes.

5.10 Even if all the residual waste that currently goes to landfill is sent to a bio-stabilising variant of MBT and 90% of the input ends up being sent to landfill (biostabilised waste, rejects and RDF), then the currently estimated landfill infrastructure could last for as much as 20 years.

5.11 **Conclusion: Ireland appears to have more than sufficient landfill void space available to handle all of the outputs from MBT plants.**

Technical challenges...

5.12 In general, **there are no major technical stoppers associated with bio-stabilising and landfilling waste**. Many projects have been implemented in other EU Member States that can be used as references if Ireland wishes to consider this route and there are a number of technology suppliers with relevant experience with this MBT application.

5.13 Using landfill[59] as a 'sink' for MBT outputs is not restricted to the 'full bio-stabilisation' variant. In fact outside Germany, Austria and Italy, a number of MBT proponents have suggested only 'partial bio-stabilisation' of the waste prior to landfilling.[60] But the **regulatory uncertainties in relation to measuring actual BMW diversion could be a barrier to the uptake of this variant of MBT.** If this variant of MBT is implemented in the short term, process performance may be an issue in the medium and longer terms if further reductions in the bioactivity are required by changes in regulations.

5.14 It is possible that there could be a demand for biostabilised outputs as **landfill cover**. Landfill daily cover is potentially a significant outlet for biostabilised outputs. But this practice would have to be approved by the Irish EPA. Even then the EU Commission may regard it as not constituting "landfill diversion" in the interest of meeting Ireland's diversion targets.

Would incineration still be required?

5.15 MBT processes, whatever their configuration, usually also produce a relatively high calorific value (CV) RDF fraction that has to be managed. In Germany and Austria local landfill regulations necessitate minimising the Total Organic Content or CV of the MBT outputs sent to landfill, hence non-biodegradable plastics and hard to degrade cellulosic materials have to

[57] Excess Landfill Capacity – Impacts on the Implementation of Irish Waste Policy, 2006

[58] Meeting Ireland's Waste Targets: The Role for MBT, prepared for Greenstar by Eunomia, 2008

[59] Using outputs as landfill daily cover is also possible, but in the UK for example, such usage will be considered as landfilling. It is reported in the Ireland's National Waste Statistics, 2006 that CLO has been used as landfill cover. There is uncertainty how such usage would be regulated in the future and whether this will meet the requirements of the landfill directive (National Waste Report 2006, EPA, 2008).

[60] The 'partial stabilisation' process option is designed to reduce the biodegradability of the waste by a sufficient degree over a short time-scale prior to it being sent to landfill. Since increasing bio-stabilisation increases operational costs and increases the size of the plant and land-take, reducing the extent to which the waste is bio-stabilised can have financial and other benefits.

be extracted from the waste as RDF prior to biological treatment. This fraction can account for 40-50% of the input waste and in countries where the bio-stabilisation variant of MBT is prevalent, the RDF is combusted alongside residual waste or in dedicated incinerators.

5.16 It should be noted that if Ireland decided to pursue this MBT configuration and landfill the RDF fraction (assuming a CV of 7-8 GJ per tonne), the energy 'lost' for recovery could be c.7,500 TJ per annum that would be enough to power 40,000 houses.

5.17 The Irish Government has pointed to Austria as an exemplar of how Ireland should move forward.

5.18 The implication of Government policy is that the RDF should be combusted.

5.19 This plastic-rich RDF is usually of relatively poor quality. Our estimates suggest that from 500 to 850 kTpa of RDF could be available from Irish MBT plants. Experience elsewhere suggests that finding outlets in existing infrastructure such as cement kilns, coal-fired boilers and industrial boilers for any significant quantity of MBT-derived RDF will be challenging.

5.20 Because of such difficulties, it is likely that **at least some of the RDF would have to be managed in either dedicated combustion plants or new gasification plants or as co-feed in the planned municipal solid waste incinerators**. Additional thermal treatment facilities could therefore be needed if Ireland adopts MBT as a significant part of its future waste treatment infrastructure.

Costs …

5.21 The disposal of biostabilised outputs in landfills **is likely to be more costly** than other approaches. In Ireland landfill fees have been amongst the highest in Europe. In 2007, the average landfill gate fee (including a landfill levy[61]) in Ireland was reported to be €130 - 140 per tonne[62] (almost double that year's average landfill cost in the UK).

5.22 If such materials can obtain approval for usage as landfill cover, disposal costs can be reduced significantly. However, prolonged maturation that takes up to 4 weeks and requires significant land area will impact upon processing costs at the MBT plant.

Achieving EU landfill targets …

5.23 **There is no certainty that any MBT-led approach where the outputs are to be sent to landfill will result in Ireland achieving its EU landfill diversion targets.** This is because there is no agreed methodology in Ireland for assessing the biodegradability of MBT outputs. Without this, one cannot determine to what extent the biodegradable content of the waste has been reduced. There is also a risk that if the Irish government policy review or the Irish EPA decides to adopt a particular system for determining the level of bio-reduction, an MBT facility's operating parameters may have to be changed (with a resultant cost impact for the operating company) to comply with the newer requirement.

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[61] The landfill levy of €15 per tonne of waste is low compared with other EU countries where they range from €40-80 per tonne. Landfill levy was introduced in Ireland in 2002 to 'encourage the diversion of waste away from landfill and generate revenues that can be applied in support of waste minimisation and recycling initiatives'. Waste Management (Landfill Levy) (Amendment) Regulations 2006: "The amount of the levy shall be €15 for each tonne of waste disposed of at an authorised landfill activity.

[62] National Waste Report 2006, EPA. Though since that report was compiled some landfills are now charging gate fees significantly below this range.

Measuring biodegradability…

5.24 In EU Member States where the landfilling of MBT outputs is a key part of the country's infrastructure in delivering EU landfill diversion targets, two main approaches are being used to measure the diversion of biodegradable waste from landfill:

- A **de minimus limit** of biodegradability, above which MBT outputs cannot be landfilled and below which the outputs are considered to have zero biodegradability[63] – used in **Germany, Austria and Italy**;
- A **measurement system**, where the reduction in biodegradability within the MBT system is measured and thus used to determine the amount of biodegradability that has been diverted. This approach, which has so far been only adopted by **the UK**, is much more complex not least because the UK Government has decided to link this to a penalty driven scheme (LATS). This allows any MBT output to be landfilled irrespective of its biodegradability, but each tonne of biodegradable waste landfilled results in a debit against allowances allocated by Government to local authorities. If allowances are exceeded in certain target years significant fines may be levied.

5.25 The approach requiring a *de minimus* limit to be met prior to landfilling is loosely referred to as 'full bio-stabilisation'. This configuration of MBT has attracted considerable interest in Ireland. Proponents argue that it would allow Ireland to avoid building new thermal plants whilst meeting the requirement of the Landfill Directive. But meeting the Landfill Directive requirements is only one aspect of a fully optimised resource recovery strategy for Ireland.

5.26 However, in the absence of an agreed methodology for assessing residual biodegradability there is no measure of what constitutes "full" stabilisation. The operator, equipment supplier and regulator may all have different views about this (not least because prolonging stabilisation significantly raises costs and increases land take). At the national level, the Irish Government, the EPA and the EU Commission may also differ about the extent to which Ireland has met its landfill diversion targets if the predominant route used is via landfilling of the bio-fraction from MBT processing. We have been struck by how few stakeholders realise that **this is a key issue** and by how little appears to be being done to address this critical issue.

6. Is export a viable option for MBT outputs?

6.1 Export of waste for recovery in other countries (although it is incompatible with principles of proximity and self-sufficiency) **is an established waste management route in Ireland due to the limited availability of local waste management infrastructure.** It is often economically viable, despite the transport costs that are estimated to range from € 25 to € 50 per tonne[64].

[63] The aim is to reduce the biodegradable content of the residual waste stream to a certain threshold level so that when it is landfilled its methane generating capability is significantly diminished.

[64] Waste Management in Ireland; Benchmarking Analysis and Policy Requirements, Forfas, March 2007

6.2 In 2006, Ireland exported approximately 75% of all recyclable materials (c. 1.6 million tonnes) with the recycling and recovery facilities in the UK being the main destination[65]. In that year, 48% of hazardous waste (c. 135 thousand tonnes) was exported, mainly for thermal treatment. The UK took for approximately 34% of all hazardous waste exports from Ireland, with other main destinations being Germany, Belgium and Denmark[66].

6.3 There are only a few examples where plants referred to as 'MBT' in Ireland have exported outputs. These examples relate to processes producing an unrefined RDF.

6.4 It was reported that in 2006, 95% of this grade of RDF (c. 26,000 tonnes[67]) was used in a cement kiln in Sweden; the remainder being exported to the UK.

6.5 **Because of limited demand for MBT outputs in overseas markets, it is unlikely other countries will be able to absorb a significant proportion of the output from Irish MBT plants** if this technology were to gain a significant share of Irish waste processing. The UK, which is the main destination for waste exports from Ireland, recognises that there is a limited capacity available to meet its 'local' needs:

> *"RDF production is forecast to increase significantly over the next few years, however, there is currently not enough suitably authorised capacity to make use of additional RDF."*[68]

6.6 It should be noted that Ireland is not the only country in the EU expecting significant changes in their waste management practices. Exactly how all these changes will affect the overall market of waste derived products is uncertain.

7. Finally…Can Ireland achieve its landfill diversion targets with an MBT-led approach?

7.1 Our analysis shows under present market conditions **none of the options for managing the outputs from new MBT plants is without issue.**

7.2 For some applications availability of adequate capacity is the major concern (e.g. use as a fuel), whilst for others it is regulatory constraints and technology challenges that pose the main uncertainties.

7.3 Options for which there may be less concerns include applications where biostabilised waste goes to landfill either for disposal or use in landfill engineering. However, this option is associated with most uncertainties in terms of biodegradability content and hence, meeting Ireland's landfill diversion targets.

7.4 There has been much discussion over recent years in Ireland about how the country should go about achieving its diversion targets, yet so far little new infrastructure has been built and there is no significant capacity operational anywhere in Ireland for managing the residual

[65] The amount of waste exported from Ireland is expected to decrease because of the introduction, in July 2007, of the revised Transfrontier Shipments (TFS) regulations, which imposed stricter controls on waste transportations to, from and through Ireland.

[66] All data are from the National Waste Report 2006, EPA, 2008

[67] National Waste Report 2006, EPA

[68] http://www.environment-agency.gov.uk/ourviews/857198/1765093/

fraction of MSW other than landfill. Government policy now favours MBT over incineration. This policy switch – and further reviews that have been announced by the Government – are likely to slow down or delay the commissioning of the required capacity.

7.5 **To an outside observer, it is not yet self-evident that if Ireland focuses on an MBT-led approach there will be sufficient operational capacity in time to meet the country's diversion targets. Ireland now only has a year and a half to develop the infrastructure required to meet the first EU target date. It is therefore quite possible that this first target for diverting biodegradable waste from landfill might be missed.**