Juniper

Briefing Note

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Title:	

10 Questions about MBT

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Important Note:

This Briefing Paper has been prepared independently by Juniper. The views expressed are not necessarily the views of CEWEP. CEWEP Ireland commissioned this report to inform the debate over the choices currently being considered for Ireland's residual waste management strategy. CEWEP had no involvement in the preparation of the report.

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Introduction

The mechanical-biological treatment (MBT) of waste has attracted much attention in recent years – largely because it is seen by its proponents as a way of avoiding the incineration of waste, whilst still complying with the landfill diversion targets set by the EU.

These advocates of an MBT-led approach see this technology as contributing to a society in which the country achieves "zero waste", maximises recycling and avoids the environmental impacts that are still seen as being inevitably associated with more traditional methods of managing waste – almost the "magic bullet" of waste management policy.

Can MBT really deliver on these expectations?

In this context, the Irish arm of CEWEP (the **C**onfederation of **E**uropean **W**aste-to-**E**nergy **P**lants) has commissioned Juniper to provide a short Briefing Paper that dispassionately and objectively assesses 10 key questions related to the use of MBT to manage residual household waste.

Juniper is recognised worldwide as the leading independent analyst of novel waste processing technologies. The company has a 15-year track record in supporting both public and private sector clients on an international basis. In 2005, Juniper published the most comprehensive review of MBT [1]. Having already been downloaded by over 5000 organisations worldwide, this report is recognised as the industry standard reference.

Since the publication of that report, awareness of MBT's strengths and weaknesses has evolved significantly. New reference plants have been commissioned, new process configurations have been tested, recent guidelines and legislation have come on-stream that directly impact on the viability of projects, and new technical and commercial issues have emerged. Undoubtedly, the overall understanding of the capabilities and limitations of this approach to managing wastes has improved significantly. Lessons have been learnt and new drivers –notably the mitigation of climate change – have emerged as an important factor in policy formulation.

This year, a 'Program for Government' was issued which places strong emphasis on the introduction of MBT facilities [2], as a solution to meeting the country's diversion targets for biodegradable waste from landfill. One contribution to the debate, which stresses the advantages of MBT vs incineration, has received widespread attention [3]. In this context, CEWEP Ireland felt that it was important for the policy debate to be also informed by a more objective evaluation of the relative merits of these two approaches.

This Briefing Note is an initial contribution to the debate[1]. It is not a comprehensive review but, rather, is designed to be an accessible – and, hence, succinct, way of raising the awareness amongst policy makers of the key issues associated with MBT. While these issues are raised, the benefits are also highlighted. In this way we hope to inform policy makers' decisions rather than advocate any particular solution over another.

[1] It is envisaged that CEWEP will commission further more detailed analysis from Juniper over the coming months. This analysis will relate more specifically to the options available to policy makers in Ireland.

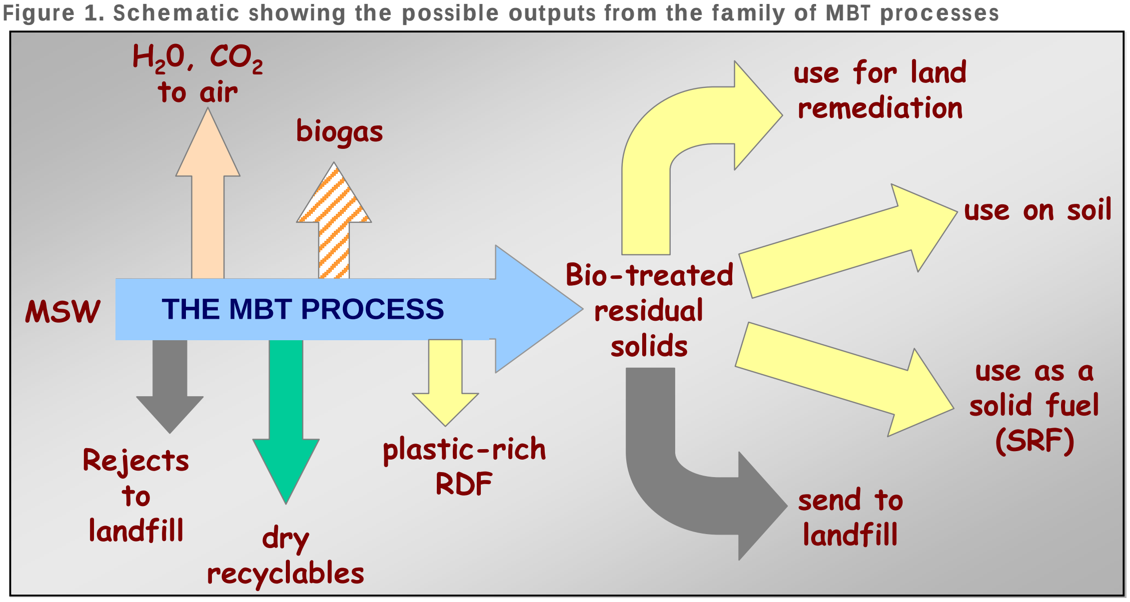
1. What is MBT?

1.1 MBT (Mechanical Biological Treatment) is a **proven, viable approach to managing residual waste,** but there a number of **potential issues** associated with its use that need careful consideration.

1.2 MBT systems use a range of mechanical and biological process elements, in a variety of integrated configurations, to process household waste into a number of outputs. Each of these configurations has its own particular advantages and disadvantages but, in all cases, the key to assessing an MBT proposal is considering what is done with the outputs from the plant. These **outputs may be used beneficially or they may be disposed of in a landfill**. In the latter case the sustainability is adversely affected from an environmental perspective.

1.3 MBT already plays an important role in helping several countries meet their waste management objectives, but **it is not a 'magic bullet': used inappropriately it can be costly, have poor operational reliability, result in significant environmental impacts and contribute little towards recycling and climate change mitigation. Used well, it can provide tangible benefits and ease political and public acceptance of new waste processing infrastructure, but it rarely provides overwhelming environmental gains relative to its cost**.

Figure 1. Schematic showing the possible outputs from the family of MBT processes



1.4 The outputs normally always include a range of dry recyclables and a fraction of rejects that typically needs landfilling. Depending on its configuration, MBT also usually produces a plastic-rich fraction, which is normally used as fuel; and a bio-treated fraction which may be usable as a soil improver or a fuel, or may be landfilled. The process also produces carbon dioxide (a greenhouse gas) and water vapour. Some variants produce biogas, which can be used as a fuel, but many others do not. Thus, it can be seen that **MBT isn't a single concept or type of technology** – instead the term is applied to a **wide range of technologies with very varying capabilities**.

1.5 **The original MBT concept for waste processing evolved in Germany some fifteen years ago**. It was a response to a strong desire to reduce the quantity of biodegradable waste sent to landfill, avoid incineration and increase the potential recovery of resources from waste. However this variant, which is also the one espoused by Greenpeace in their 'Cool Waste Management' discussion document [4], is proven in use in that country and others, but it **relies on continued use of landfill, does not maximise resource recovery from waste and can be costly in countries, like Ireland, where landfill is expensive**. Since that time other variants have emerged that seek to increase the percentage recovery of resources from the waste.

1.6 Over time, the term 'MBT' has come to mean different combinations of process elements with different functionality in different countries. This has increased the confusion about what MBT can - and cannot - do, as national experts focus upon particular features of the configuration most widely considered in their country and highlight specific advantages or disadvantages that may not be relevant for another project in another country where market conditions, the regulatory framework, policy objectives or economic factors are likely to be different. This is particularly noticeable when comparing the biostabilisation-to-landfill approach, which has been widely adopted in Germany, with the MBT-to-SRF[2] that has received widespread attention in the UK.

1.7 Now, 'MBT' can mean almost any process for treating Municipal Solid Waste (MSW) that has mechanical and biological elements and, indeed, we know of some facilities described as 'MBT plants' that have no biological component and which should be more correctly described as MRFs[3] or MHT[4] plants. Also, plants that are operated in an integrated manner with a necessary thermal element[5] are still referred to, usually for political reasons, as MBT. Examples already exist in Germany, Austria and Italy and plants proposed in some municipalities in the UK will be of this type. We have seen MBT plants that use simple enclosed windrow composting (with very rudimentary mechanical steps) and others which are fully integrated, sophisticated facilities that incorporate state-of-the-art mechanical pre- and post-treatment sorting

[2] SRF = **S**olid **R**ecovered **F**uel

[3] MRF = **M**aterial **R**ecycling **F**acility

[4] MHT = **M**echanical **H**eat **T**reatment

[5] All MBT processes will produce a non-biodegradable plastic-rich fraction, usually referred to as **R**efuse **D**erived **F**uel (RDF), which requires an outlet. In some EU Member States this material is sent for incineration or for utilisation in cement kilns. Elsewhere, dedicated facilities have been built to combust the RDF. This latter trend is becoming more widespread as capacity for RDF within existing thermal infrastructure is becoming very limited.

technologies and automated biological systems with state-of-the-art 'fuzzy logic' process control systems. Such plants are complex and costly and require skilled personnel to operate them reliably, whereas simple windrow compostors are, in principle much cheaper but may have other significant disadvantages.

1.8 Because the term MBT is applied to a broad range of processes, much **confusion** can arise about the true capabilities of MBT: since something can be an advantage of one type of MBT but a disadvantage of another variant. It is therefore difficult to provide objective, factual information that applies to all types of MBT. Simple summary statements tend unfortunately to be over-simplifications. **Each individual process concept has its own advantages and disadvantages**; although MBT advocates often give the impression that all advantages are attributable to all types of MBT. Likewise, all disadvantages do not relate to all process designs. In short, it is important to consider the balance of specific benefits and issues that relate to each specific set of circumstances and base decisions on an objective appraisal of that particular approach.

1.9 **MBT is often seen as an alternative to incineration**. It sometimes seems that some supporters of MBT see this fact alone as its main advantage. In our experience many political decision-makers are surprised when they realise that **most MBT-led approaches to waste management do also involve burning waste**.

1.10 Unlike some other more traditional waste management solutions, **MBT isn't a complete solution.** This is probably the **biggest issue** for MBT projects, since they are dependent on **securing viable, long-term solutions for the outputs from the process, specifically as these outputs can have a residual level of biodegradability and can impact on landfill diversion targets if they end up being landfilled**. There are significant challenges associated with each of the options shown in Figure 1.

1.11 When one looks around the EU, some MBT projects are not designed to maximise recycling and resource recovery or minimise the impact of waste treatment on the environment. Instead the driver is to meet local landfill diversion targets, which, because of their immediacy, can often be out-of-step with longer term environmental and sustainability goals.

1.12 **A concern therefore for Ireland is that** whilst MBT may mean one thing in certain countries because of the regulatory framework that requires systems that exhibit high process and emissions performance, **MBT can be implemented in a much more basic manner** - in a different regulatory or policy climate - **which is neither environmentally beneficial nor a sustainable solution for effective long-term waste management**.

1.13 Where the bio-stabilised output is to be disposed to landfill, the availability and cost of landfill void space is critical, not just in the short term. This implies that **a**

community which elects to place a high reliance on the type of MBT advocated by Environmental NGOs may also have to accept the need for new landfills.

1.14 Essentially therefore, **'MBT' means different things to different people**; its level of performance being heavily influenced by the key drivers and the stringency of the prevailing regulations. **The key is therefore to understand the real benefits certain designs can bring within a specific waste management framework** and assess how the MBT plant will fit in alongside, or replace, existing waste management infrastructure to provide an overall better and more sustainable solution.

2. Can MBT be a total solution for Ireland?

2.1 **No, MBT cannot be a total solution**. MBT processes inevitably produce residual/reject fractions that require either thermal waste processing capacity or a continuing supply of new landfills. These residual fractions can be more than 60% of the input tonnage in some configurations. However it should also be noted that all commonly employed waste management technologies produce a reject or residual fraction, e.g. the ash from incineration, which is 20-30% by weight. Thus **it is wrong for critics to imply that MBT is worse than other approaches, but equally, it is incorrect to state that MBT alone is all that is needed to manage a community's residual waste**.

2.2 **Of those EU Member States that have already met their diversion targets, none relies solely upon MBT. All either use** MBT alongside a well established waste incineration infrastructure, while others essentially rely on incineration for residual waste processing (as environmental leaders, these countries also all obviously have comprehensive recycling and waste minimisation programmes).

2.3 **MBT used on its own will not maximise the sustainability of Irish waste management**. MBT infrastructure can, in theory, be used on its own – without the need for incineration – to deliver Irish compliance with the limited diversion of waste that is mandated by the EU Landfill Directive, but it is not a complete solution in the sense of maximising resource recovery from waste and minimising the environmental impacts of waste.

2.4 It is self-evident that the types of MBT that are configured to produce a solid fuel, either as one of a number of outputs or the main output, require additional infrastructure that can accept this fuel. Opportunities for using existing infrastructure are limited: Ireland has no existing incinerators that could utilise this fuel and the scope for burning the fuel in cement kilns or power stations is limited by a combination of technical factors, capacity limitations and the reluctance of the operators to accept the material except perhaps in return for a significant gate fee. Therefore **it is possible that if Ireland adopted MBT this would lead to a need for new, thermal, waste processing infrastructure, which is exactly what some**

politicians are seeking to avoid by adopting an MBT-led approach. The actual supply-demand balance for fuel outlets requires careful evaluation[6].

2.5 Similarly, if Ireland adopts the type of MBT-to-landfill solution proposed by some then this may necessitate additional new landfills, which many experts regard as a relatively under-evaluated issue in regards to the environmental impact of certain MBT configurations – indeed the environmental impact of landfills is the reason for the landfill diversion targets which this strategy is trying to deliver; therefore it would be ironic if the net result of their policy direction was the creation of new, long-term landfill sites.

2.6 The only route that seems at first sight not to need additional infrastructure is the MBT-to-CLO[7] variant, where the biostabilised output is spread on land as a soil improver. However there are two issues associated with this approach: firstly not all the output can be used in this way – there will be significant rejects, as already pointed out, that require landfill or a fuel outlet, so the problem outlined above will still apply to this variant; and, secondly, the scope for spreading large quantities of low grade 'compost' is limited[8].

2.7 So, while MBT can help Ireland improve the sustainability of its waste management practices, it is not a standalone solution and has to be part of a broader commitment to a more integrated waste management infrastructure that embraces a wider range of technologies that play specific roles in recovering the resource value of the country's waste.

3. Are all types of MBT positive for the environment?

3.1 **Used appropriately MBT can be a responsible and effective solution in environmental terms**. But it is generally believed that, because an MBT plant does not directly burn waste, it must be better for the environment. This line of thought is **simplistic** and not necessarily true.

3.2 **All waste management options have an impact on the environment, as do all industrial activities and most consumer activity**. The issue is therefore not whether the use of MBT is good for the environment but rather whether or not it can lessen the environmental burden of managing society's waste relative to traditional methods such as landfilling or incineration.

[6] CEWEP is considering asking Juniper to conduct such a review that would build upon and update earlier analysis by the company and others.

[7] CLO: **C**ompost-**L**ike **O**utput

[8] An evaluation of the capacity in the context of existing landspreading, nitrate loading and potential contamination of the soil is envisaged for later in 2007.

3.3 **Answering this question is far from straightforward**. Many of the studies or software tools that seek to do so are pseudo-quantitative efforts[9] that ascribe values to each of the environmental benefits and dis-benefits and so draw up an arithmetic 'balance'. These have been criticised by some experts[10] because the result of each is so dependent upon the assumptions that the author of the study has to make and because different studies give varying conclusions to the same question. These different answers can be attributed to:

- different definitions for system boundaries (e.g. waste transport is excluded in some studies and emissions from manufacture of ancillary materials required for gas and wastewater treatment is excluded from most studies);
- varying data used for the same input, derived from different studies in different locations, years or levels of aggregation;
- different estimates used for key variables because data is unavailable, or use of 'indicative' 'data' from process companies, which, at its worst, is no more than a sales claim or an aspirational target for a system that has not yet been built; and
- varying assumptions made about what the outputs of these technologies are credited for, in terms of GHG savings (as discussed later in this Briefing).

3.4 In the UK alone, there have been many studies comparing waste disposal technologies using Life Cycle Analysis, including a report from Eunomia [8], two studies cited in a Friends of the Earth briefing [9], 55 LCA studies reviewed by WRAP [10], and a study conducted by AEA Technology for the European Commission [11]. These studies quite often reach different conclusions.

3.5 Thus, it is easier to criticise such assessments than to validate them, making it **difficult to reach clear-cut conclusions on which approach is 'better'[11] in environmental terms**.

3.6 In our experience, **the environmental performance of an individual MBT facility is very dependent on the specific process configuration, the way it is configured, the fate of the outputs from the plant and the way that it is managed**.

[9] using tools like Life Cycle Analysis

[10] Shortcomings of LCA have been discussed extensively. Burgess and Brennan [5] offer a concise and complete review of these problems. There are concerns regarding accuracy and reliability of LCA studies, which strongly depend on the quality of the data. LCA data is often too old, too sparse, too averaged, and used imprecisely across different locations, technologies and situations. Uncertainties can be so high that they render the analysis unrepresentative. Ayres [6] even points out serious inconsistencies such as disappearance or creation of mass and energy. Schaltegger [7] argues that the global aggregation of interventions with local impact at different places provides very questionable results and may lead to wrong decisions.

[11] strictly speaking 'less bad'

3.7 **All well managed plants will generally have a low environmental impact**, whether they use MBT, or any other technology; but because of the diversity of types of MBT, the variation in environmental performance between plants is greater than say the variation between modern, state-of-the-art incinerators.

3.8 The environmental impact of a process can be determined by assessing the degree to which processes abate their emissions to air, water and land. Figure 2 summarises these issues for MBT and incineration.

3.9 **In the countries that have led the development of MBT (Germany and Austria), there are specific, stringent regulatory requirements that set clear process and environmental performance goals for all MBT facilities, irrespective of the process configuration or technology implemented at individual plants**. This is similar to the tight regulatory framework governing the incineration of waste throughout the EU. Hence, at MBT plants in those countries, the level to which the bio-outputs need to be stabilised is stipulated by law, mandatory emissions limits are specified, quality standards for outputs used on soil are tight and enforced, and the thermal processing of the non-recyclable plastic-rich fraction via incineration or combustion in cement kilns is encouraged. This is not the case in many other countries.

3.10 **Emissions to air**: The main emissions to air associated with MBT are dust, odours, bio-aerosols[12] and volatile organic compounds (VOCs). In certain AD-based MBT systems that combust biogas, emissions of carbon monoxide and oxides of nitrogen are also important.

3.11 **Many modern MBT plants incorporate systems to manage and treat the pollutants** that are usually of concern, though there is more variation within the EU in the degree of abatement for MBT plants than incinerators, where abatement methods have been standardised.

3.12 **Fugitive emissions of odours and bio-aerosols have been known to occur outside plant boundaries**. The impact of the latter, as it relates to all of the many configurations of MBT, does not appear to be well documented, though we are aware of studies [12,13,14] that have been conducted on the impact of bio-aerosols from composting plants treating organic waste and impacts of releases associated with the general handling of waste.

[12] Bio-aerosols are micro-organisms and other very small biological particles suspended in air. They are respirable and normally invisible. They are of increasing concern to regulatory authorities in several countries because fears have been expressed that bio-aerosols may cause 'flu like, asthmatic or allergic symptoms.

Figure 2. Environmental impacts associated with MBT and Incineration

CLAIMED ADVANTAGE	MBT	INCINERATION
Plant profile (See Figure 3)	Process can be designed to have a relatively low profile, but may not always be so, depending on which supplier's technology is selected. Tallest structures are the digesters in AD-based MBT plants, which can be designed to look like farm silos. On some plants, digesters can be over 30m high. Some types of plants do require chimneys.	Tall chimney stacks (often over 50 m) are a feature of many MSW incinerators worldwide. Innovative architectural designs are now being used on some, but by no means all, plants to lower their visual impact and increase public acceptance. This has a significant cost implication.
Odours	Odours can be an issue for some MBT projects. The most widely reported relate to AD-based MBT plants. Odour issues can usually be resolved through a combination of good-house-keeping and implementation of proven abatement systems.	Rarely an issue for modern state-of-the-art incinerators. Good housekeeping is also a pre-requisite for maintaining control of plant odours from waste reception and storage areas.
Landtake	The footprint will depend on the type of MBT system implemented. The bio-drying types of MBT plants that treat the waste for a few days rather than many weeks often have a smaller plant footprint that most other types of MBT. However, in general, the area occupied by MBT process buildings is larger than for a similar capacity incinerator.	Actual footprint for buildings is usually amongst the lowest for MSW treatment plants per unit of capacity. However, the overall site (weighbridges, landscaping etc.) can be larger and in specific cases as big as with some types of MBT.
Emission of bio-aerosols	MBT processes can produce bio-aerosols. Though studies have shown that these can have a health impact, little information is available specifically in relation to releases of bio-aerosols from MBT plants. Measures to abate fugitive emissions from MBT have been implemented in many MBT plants as a way of minimising releases of bio-aerosols.	Bio-aerosols are not usually an issue for incinerators. The design of the facility readily addresses this potential issue.
Emission of dioxins and furans	Not an issue in relation to MBT technologies, since the processes do not operate at temperatures where dioxin formation is a concern.	Though many, highly reputable studies have indicated that dioxin emissions from new state-of-the-art incinerators are minimal compared with other sources, Green Groups worldwide continue to lead strong public objection to this technology on these grounds.
Other emissions	MBT processes produce a liquid effluent that has to be managed. The quantity of the liquid effluent stream is dependent on the specific type of MBT being used, the composition of the input waste and the off-gas cleaning system that has been implemented. However, managing this effluent is not normally a cause for concern. Hazardous contaminants, such as batteries, need managing appropriately.	The majority of modern incinerators do not produce liquid effluent. As the technology utilises high temperatures to convert waste, a range of other potential gaseous pollutants have to be adequately abated. Levels are stipulated in relevant EU-WID. APC residues need to be disposed of in hazardous waste landfill.
Climate Change	CO_2 emissions from MBT processes are biogenic and their climate change impact is regarded as negligible. MBT configurations that only partially bio-stabilise waste for landfilling can have a significant negative impact. Account also needs to be taken of the fate of other MBT outputs. For example, the plastic-rich fraction is often sent for combustion, which in many cases, can be deemed as having a GHG 'saving' as it can displace fossil fuels. In certain specific cases the overall impact could be negative.	Energy recovery from waste can displace fossil-fuel derived power, but some experts have cast doubt on how real the net benefit is, especially for those plants that have low efficiencies.

3.13 In contrast to the relative lack of information about possible emissions from MBT plants, the potential issues related to emissions from incinerators are well known and, as a result, there have been strict requirements for waste incinerators operating in the EU since the late 1990s [15]. Thus, incinerators are subject to very strict mandatory limits on emissions across the whole EU, whereas there is no equivalent standard expressly for MBT processes. There is also a vast body of detailed environmental data on the actual performance of new incineration plants that can be used in a statistically significant manner to underpin confidence in the low level of emissions achieved by new state-of-the-art incinerators. Data from MBT plants is available, but, as continuous monitoring of this type of process is rarely required, the quality of the data is not as good as for incinerators and, so, comparisons are not straightforward.

3.14 A more recent study by Germany's Umweltbundesamt [16], where there are about 70 incinerators treating a total of about 18 million tonnes of MSW[13], concluded that "because of stringent regulations, waste incineration plants are no longer significant in terms of emissions of dioxins, dust and heavy metals".

3.15 All processing of waste by thermal or biological means will generate carbon dioxide, but the amount per tonne of input waste may be less for an MBT plant. Even though this gas is not considered as a potentially harmful pollutant, it will have a greenhouse gas (GHG) impact. **In GHG terms there may be significant positives in using some types of MBT to manage waste**. This topic is considered later.

3.16 **Water Effluents**: Many MBT plants produce wastewater that may require treatment. Though this is a significant cost addition, it would **not normally result in any direct environmental harm**, since there are standard techniques for managing liquid effluent. There are obvious, minor, secondary impacts in terms of resource utilisation and energy consumption. It should be noted that most modern incinerators do not generate wastewater but, do instead, produce a small quantity of more harmful, secondary solid residues that need to be disposed of in a hazardous waste landfill. **This is a disadvantage of incinerators**.

3.17 **Solid Outputs**: Depending on the process configuration, the type and composition of the solid outputs from MBT will be different. Therefore, their impact on the environment will depend on how each of these outputs is subsequently managed.

3.18 If the bio-treated output is spread on land, there can be considerable environmental benefit or harm – it is therefore very important to carefully evaluate this option. In particular a poorly designed and operated MBT system that produces a low grade 'compost' which if spread too intensively or inappropriately may have a considerably worse impact on the environment – through leaching of heavy metals to soil and

[13] The UK has 19 MSW incinerators treating about 4 million tonnes of MSW.

excessive nitrate levels resulting in groundwater contamination – than a new state-of-the-art incinerator would have. This does not mean that incineration is 'better' than MBT, but rather that it is very important not to accept over-simplistic claims by advocates of MBT that it is always better in environmental terms and neglect to put in place adequate safeguards over the choice, design, operating conditions and management routes for the outputs from any proposed plant. This is, after all, no more than has already been done for incinerators in the EU since 1989.

3.19 An example of this issue relates to those MBT plants that incorporate shredders and similar equipment prior to sorting which will disperse any hazardous materials contained in the input waste (such as lead, cadmium and mercury from batteries) throughout the solid outputs. Such systems can therefore **result in the release of low levels of contamination into the environment, via for example land-spreading of 'composts' derived from some configurations of MBT plant**. In our opinion there should be greater awareness of this potential issue, since it can be addressed through changes in process design and waste management practices. This is one example of why we are concerned that **the view promulgated by some that 'incineration=pollution' and 'MBT=no pollution' is too simplistic and potentially misleading**.

3.20 Several other aspects of the environmental performance of MBT are addressed in following sections of this Briefing Note.

4. Is MBT better for the local community than incineration?

4.1 Because politicians worldwide are finding it easier to countenance MBT relative to incineration, because public opinion favours biological processing of waste over thermal methods, there appears to be a general assumption that MBT has a lower impact on the local community than EfW. But as we have seen, specific types of MBT will have both advantages and disadvantages for the local community. **It is not correct to assume that all MBT-based solutions are 'better' for the local community than incineration.** In our experience, local decision makers do not always appreciate that some configurations of MBT can have a significant adverse impact on the local community.

4.2 We have already discussed emissions. Additional factors that are of importance include the amount of traffic associated with a facility (vehicle movements), how big the plant will be (footprint, height of buildings and chimneys and the overall visual impact). Noise and odour are of particular concern.

Figure 3. Examples of MBT and EfW plants operating in the EU and Canada

Examples of MBT Plants

Erbenschwang, Germany

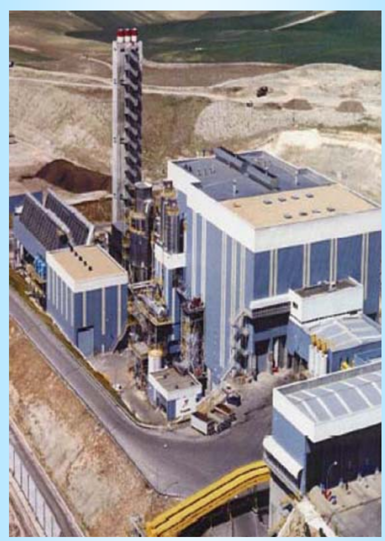
Hille, Germany

Edmonton, Canada

Examples of EfW plants

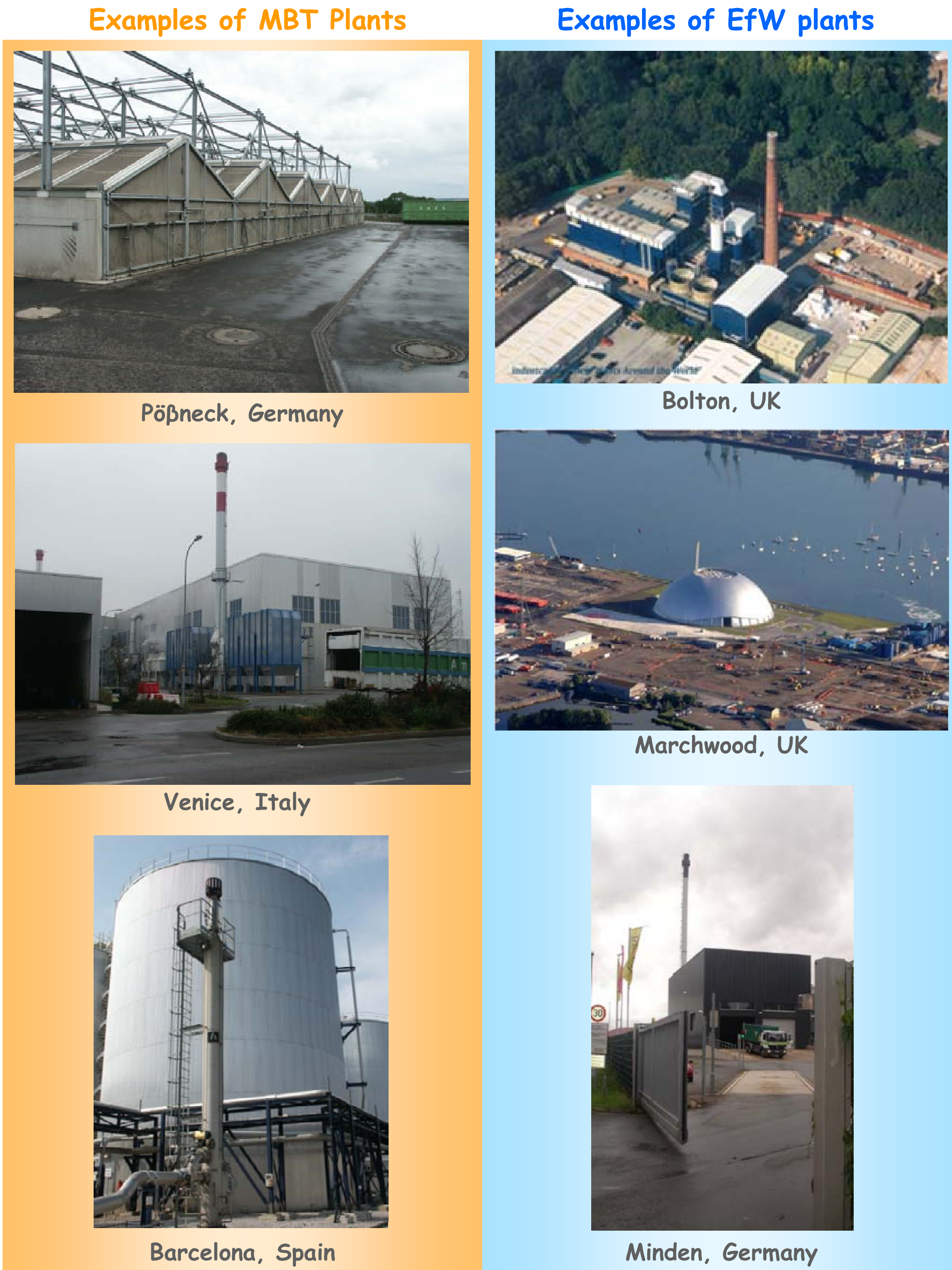
Isle of Man, UK

St Ouen, Paris



Madrid, Spain

Figure 3. Examples of MBT and EfW plants operating in the EU and Canada (cont.)



4.3 **Health impacts**: The potential health impacts of waste treatment plants have been the focus of a number of independent studies in the EU and elsewhere. One such study conducted in the UK for DEFRA [17] "*did not find a link between the current generation of municipal solid waste incinerators and health effects*." The report makes clear that "*adverse health effects have been observed in populations living around older, more polluting incinerators and industrial areas. However, the current generation of waste incinerators result in much lower levels of exposure to pollutants. We considered cancers, respiratory diseases and birth defects, but found no evidence for a link between the incidence of disease and the current generation of incinerators*." Since all new incinerators in Ireland would be, by definition, current generation or better, the clear-cut nature of the conclusion should, in our view, have received greater recognition in recent reviews prepared for Irish decision makers. This **UK Government commissioned study, whose findings were accepted by the Chief Medical Officer, highlighted the lack of information and poor data quality in relation to MBT, which makes it difficult to reach any definitive conclusions, positive or negative, about the health impacts of MBT**.

4.4 There is in general a paucity of information in relation to the impacts associated with emissions from MBT plants. The effects associated with bio-aerosol emissions from such facilities are not yet well documented and the related health impacts relatively poorly understood. A few studies have separately shown that there could be links between MBT component processes [12,13,14,17] and the adverse health effects on plant workers and residents living nearby. But these studies do not relate to MBT per se, thus there is uncertainty over whether modern MBT plants do have similar issues of fugitive plant emissions or whether such emissions are adequately managed using current abatement measures.

4.5 **Odours**: Odorous emissions are rarely an issue for modern energy from waste plants (whether they use gasification, pyrolysis, plasma or combustion), but are of particular importance for some types of MBT. Because of the underlying biology of MBT systems, the process will produce odorous gases such as hydrogen sulphide (H_2S) and ammonia (NH_3), which must be controlled very effectively to avoid complaints from neighbours. **Well established techniques are available for abating these emissions** but their efficacy relies upon good housekeeping and operational procedures by the plant managers. Systems should be procured from suppliers with a long and favourable track record validated through relevant reference plants. Customer public authorities and regulators should ensure that cost-cutting on equipment specifications has not led to such relatively costly elements of the plant design being under-specified. This is particularly important since **several MBT plants have had complaints by local residents related to persistent odour problems**.

4.6 **Landtake**: On landtake, MBT will perform worse than incineration, as it will have a considerably larger demand for land area. Our analysis indicates that **many types of MBT plant will have a footprint 40-80% greater than an incinerator of a similar capacity**.

4.7 **Vehicle movements**: The impact on the local community of vehicle movements is a concern with any new waste treatment plant. For a plant of a certain capacity, there is no straightforward relationship between technology, MBT or incineration, and vehicle movements. But the rule-of-thumb is that the greater the degree of fractionation of the waste (i.e. the more recyclable or reject streams separated from the waste) the greater the number of vehicle movements. The degree of waste fractionation is normally higher in MBT plants, which means that in general vehicle movements may be slightly higher, but strategies to improve the recycling element of incineration to bring this technology in line with desirable recycling objectives, mean that significant mechanical pre-sorting is now being considered or being implemented, making any difference small.

4.8 **Visual profile**: This is **one of the main issues associated with incineration plants.** Because there are economies-of-scale with this type of facility, the physical buildings are large and they have a highly visible stack (chimney), which can be up to 60 metres in height. **MBT plants by contrast can be configured in relatively low profile structures** and, typically, have lower unit capacity – but this means that **to handle a given quantity of waste more MBT facilities will be needed affecting more sets of local neighbours**.

4.9 Some AD plants (including MBT plants which incorporate an anaerobic digestion element) have relatively tall digesters, up to 30 metres in height, but these often do not cause significant opposition from local residents as they can be made to look like farm silos.

4.10 Because of the negative impact of incinerator stacks, many modern plants have used innovative architectural designs to soften the visual impact. This is costly, but where such treatments have been used, it seems to ease community acceptance of the facility.

5. Can MBT help Ireland to deliver its landfill diversion targets?

5.1 **Yes,** MBT can contribute to Ireland's EU landfill diversion targets; **but, whether Ireland can achieve its targets by using MBT without thermal waste processing, is a far more complex question** because the outputs from MBT can have a level of residual biodegradability and therefore have to be managed in a way that minimises their impact on EU landfill diversion targets. In contrast, ash from MSW incineration is not normally biodegradable and there are relatively well establish outlets in the EU for this output.

5.2 The degree to which MBT can help to meet the EU diversion targets (which relate to the diversion of biodegradable waste from landfill) [18] **depends largely on which type of MBT configuration is selected**. Whilst some types of MBT processes are traditionally configured to reduce the readily biodegradable content of the waste by an appreciable amount, **many of the most commonly promoted systems achieve negligible reduction in biodegradability**.

5.3 MBT technologies that make fuel that is then utilised, usually deliver high levels of performance against diversion targets. When the process is designed to produce a bio-treated output that is then landfilled, its performance against EU targets could vary greatly. The extent of the bio-reduction is affected by operating conditions, particularly the length of the ‘maturation’ period. Since longer maturation has a cost and scale impact, some operators may seek to limit this, and hence the output may have residual biodegradability which could impact on performance against diversion targets.

5.4 Answers to this question given by suppliers and proponents of MBT regarding landfill diversion can be confusing. Relatively little data on the reduction in the level of biodegradability is available at the present time. Instead companies refer to the diversion of material (by weight) from landfill, instead of the diversion of the biodegradable fraction of the waste from landfill – which is the measure used to assess diversion in accordance with EU targets. Some types of MBT **can achieve significant landfill diversion on a weight basis**: our published analysis [1] indicates **as much as 90%**, significantly reducing reliance on landfill. But we have pointed out that **in other cases the mass diversion rate can be as low as 10%**. This is another illustration of the danger of generalising about the performance of MBT technology.

5.5 The diversion is also obviously affected by the **ability to secure outlets for the process outputs**. If there are established markets for the outputs, MBT can help deliver high levels of biodegradable diversion. If markets fail and/or process residues are to be sent to landfill, less waste would be diverted and diversion rates would depend on the residual biodegradability of an output.

5.6 This shows that assessment of MBT technology in terms of its ability to deliver EU Landfill Directive targets is not so straightforward and should be done **on a project specific basis**.

6. Is incineration avoidable?

6.1 Incineration of municipal solid waste can be avoided. Other energy from waste options, such as gasification, could be used instead but these are either less proven or more costly and generally have similar environmental performance, so **the benefit of switching away from incineration is not obvious** given the current stage of development of alternatives.

6.2 We have already shown that certain types of MBT can be configured to deliver Ireland’s landfill diversion targets but that a waste management strategy that avoids incineration would pose significant challenges, given the lack of alternatives to landfill at the present time.

6.3 All MBT plants will produce a plastic-rich fraction (usually referred to as RDF). This accounts for about 40-50% of the outputs from MBT. In Ireland, the quantity is likely to be at the upper end of this range because of the current low recycling rates. Elsewhere in Europe, the RDF is usually sent off-site for thermal treatment in incinerators or cement kilns, though advocates of MBT are often keen to play down the use of such outlets.

6.4 The capacity for utilising RDF in existing infrastructure in Ireland is limited. The UK faced a similar issue a few years ago when MBT became popular and this led to significant issues – not least a **reluctance on the part of waste management companies and banks** to accept the risks associated with securing access to this limited capacity. This led to a number of high profile local Authority MBT contracts having to be abandoned. Similar issues could be experienced by Irish Local Authorities.

6.5 **The solution adopted by some in the UK has been to develop MBT as part of a wider infrastructure that now includes some form of Energy from Waste (EfW)**. Inclusion of a thermal treatment plant (typically a combustion plant) addresses the 'bankability' issue but increases the overall cost. This has led some to question why political decision makers would prefer a two-stage MBT-incineration approach to a cheaper, equally effective, single stage incinerator – but the fact is that many in the UK, Italy and elsewhere do.

7. Are certain types of MBT unsuitable for Ireland?

7.1 Potentially yes, if suitable outlets for the secondary materials produced are not available, whether these are land for CLO, thermal plants for SRF and RDF or landfills for residual fractions. At this stage all that can be said is that **it would be inappropriate to put in place MBT infrastructure without ensuring that these other capabilities are also available**.

7.2 In our opinion, **Ireland needs to adopt an integrated, carefully considered approach at both national and local level**.

8. Can MBT boost recycling?

8.1 **Yes, but not to the extent that is commonly believed**. **It is not generally understood that most MBT plants are not configured to maximise recycling and resource recovery** – and this is certainly not the impression given by documents that promote this approach to managing waste. Instead, the majority of facilities are designed to bio-stabilise the waste and meet landfill diversion targets. After source segregation, **MBT can boost materials' recovery to 3-15% of the residual waste**.

8.2 The suppliers and operators of MBT plants that report 60-85% recycling rates are including the compost-like output (CLO) within this figure; assuming that it will be used beneficially. But, little of this material is actually used as a compost, much more is used as daily cover on landfills. It is a matter of judgement whether this latter use should be regarded as recycling in the sense that the general public understands the term. **Upgrading this material to enhance its properties as a soil improver may be uneconomic.**

8.3 The quality of the recyclables that are recovered should be of greater concern to policy makers. The bulk of the materials recovered are contaminated. While it is possible to improve the quality by further processing, few facilities do this because of the cost. It should also be noted that this upgrading does itself involve additional secondary environmental impacts (more energy and water use, and the creation of secondary wastes that themselves require management), so it is not self-evident that it is always beneficial environmentally to improve the quality or quantity of recyclables produced by an MBT plant. Moreover, because of the incremental costs, it is very likely that the commercial companies that operate such facilities will not put in the equipment to do this secondary processing unless required to do so, in which case they would almost certainly require a higher gate fee.

8.4 In the UK, it is starting to become more difficult to recycle the low quality materials that are currently being produced by MRFs or MBT plants. For example, leading recycling companies have warned that they might not take UK recyclables and instead import them from abroad if their quality does not improve[14]. Where they do take the material, ferrous and non-ferrous metal recyclers offer lower prices for the output from MBT plants because of the contamination. Fractions such as glass and mixed plastics, which are frequently claimed to be recyclables that can be recovered from MBT, can end up being landfilled, because of their poor quality, adversely impacting on the overall environmental performance of the plant and also incurring additional, often unbudgeted, costs. More generally, a campaign for "Real Recycling" in the UK is pressing Central Government and Local Authorities to emphasise the need to improve the quality of materials collected for recycling[15].

8.5 Thus, since the supply/demand balance for recyclables is notoriously volatile, an intensive emphasis by the Irish Government upon recovering such materials via MBT-plants could result in a glut of poor quality materials that would not be able to be recycled in a beneficial manner; instead such materials may have to be 'downcycled' into 'products' with a far lower resource value or exported to developing countries – both of which would impact upon the overall sustainability of an MBT-led approach.

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[14] LetsRecycle.com, 2007. "Real" recyclers considering changes to buying strategies. Published on 21 May 2007. www.letsrecycle.com/do/ecco.py/view_item?listid=37&listcatid=224&listitemid=2097 (last accessed on 3 October 2007).

[15] Campaign for Real Recycling. Website link: www.realrecycling.org.uk.

8.6 It is also worth noting that any waste treatment plant, regardless of which core technology is used, can, in principle, recover materials from residual waste. For instance, incineration can recover materials from the feed, with the appropriate mechanical treatment. Ferrous metals can also be recovered from the ash. It is, therefore, incorrect to say that incineration is incompatible with recycling.

9. Can MBT help Ireland's Climate Change agenda?

9.1 **Yes, it can, but the extent to which it contributes will vary**, depending upon how the MBT plant is configured and how well it is integrated into an overall waste and energy infrastructure.

9.2 In our view **too much emphasis is placed upon which technologies are used (e.g. incineration versus MBT) than on how well the waste management system is integrated with energy production and utilisation.** This latter factor will play a far greater role in mitigating climate change than the former. For many years this straightforward factual position has been known by technical experts and recognised by policy makers in Scandinavia. Many environmental NGOs have yet to recognise this and maintain their long-standing and, arguably, outdated opposition to incineration and gasification rather than focusing on the overall contribution that a properly balanced portfolio of technologies can play in displacing fossil fuel and mitigating climate change impacts. Specifically the role of Combined Heat & Power production, co-gasification of waste derived fuels (from MBT plants) and integrated biogas/syngas/landfill gas upgrading and utilisation for transport fuels can be far more beneficial in climate change terms than the MBT-to-land or MBT-to-landfill systems that are favoured by many environmentalists.

9.3 Well integrated approaches can also contribute greatly to an overall mitigation of climate change impacts by providing a range of products that can help offset the environmental impact of producing them from primary raw materials[16]. But quantifying the contribution is complicated by the need to confirm that recovered products actually displace products or materials that would otherwise have been used.

9.4 **MBT configurations that recover energy are likely to help ameliorate climate change more effectively than those that do not.** Some MBT plants fully bio-stabilise the biodegradable fraction of waste without energy recovery and then landfill the rest (after recyclables are recovered). These types of MBT, which are the ones normally favoured by environmental NGOs, do not take advantage of the potential savings in GHG emissions and do not offer holistic solutions to climate change.

[16] For instance, RDF could replace coal, compost-like output could replace conventional soil improvers, and electricity from EfW could displace electricity from fossil fuels.

9.5 The actual carbon balance for a specific MBT-to-fuel solution will be dependent upon many factors including the type of process technology used, whether or not waste heat is captured for use, whether the fuel plant is located away from the MBT plant, the efficiency of the fuel conversion technology and the way that other secondary outputs are managed. **Each individual MBT configuration could be better or worse in climate change impacts than any direct incineration or gasification plant that was under consideration as an alternative**. When one takes into account the energy requirements of the MBT plant and the carbon impacts of transportation of the derived fuel, an MBT-to-fuel configuration might have a worse carbon balance than a modern, efficient incinerator, especially if the latter operates in Combined Heat & Power mode. This is not as widely appreciated as it should be. **Therefore it is important that policy makers should not assume that MBT is always better than incineration in this respect**.

9.6 In terms of direct emissions from waste treatment, both MBT and EfW can drastically reduce the emissions of methane[17] that would be generated in landfill (although when outputs with residual biodegradability are landfilled, they will emit greenhouse gases). However, EfW releases the carbon from the organic non-biodegradable matter as carbon dioxide; whereas, in the case of MBT, whether carbon dioxide from this fraction is released depends on the end-use of the output: if it is used as an RDF or SRF, then it will end up in the atmosphere as CO_2; if not, **MBT may result in lower greenhouse gas emissions than alternatives. This could be a significant advantage**, but it is important to realise that many MBT plants, because of the particularities of the project, will not give this benefit; the analysis, as with so much else related to MBT must be done on a case-by-case basis.

9.7 We have already noted the varying conclusions reached by different Life Cycle Analysis of the merits of MBT vs incineration and commented that these derive from differing assumptions.

9.8 For instance, in the AEA Technology report [11], composting and AD performed well. However, the report assumes that the compost-like output (CLO) produced by these technologies will displace mineral fertilisers, which is questionable.

9.9 Similarly, recovered materials can have an impact on the estimates of overall GHG savings. Reusing recovered aluminium, for instance, can bring savings of up to 90% GHG emissions when compared to producing primary aluminium. Comparatively, while producing 1 kg of pig iron generates less than 1 kgCO_2eq, producing 1 kg of primary aluminium generates circa 10 kgCO_2eq[18]. Therefore, the assumptions about the materials that a process recovers and the extent of recovery can have a decisive influence on the outcome of comparative analyses. One analysis [4] that received extensive coverage seemed to have credited MBT with recovery of non-ferrous

[17] In terms of climate change, methane is over 20 times more harmful than carbon dioxide.
[18] Values obtained from the Ecoinvent database.

metals whereas no such benefit appeared to have been given to incineration, resulting in an unfavourable conclusion on the relative merits of the latter versus the former. Given that many EfW facilities around Europe recover non-ferrous metals – and all could do – this seemed to be a misrepresentation of the underlying facts. Adjusting for this anomaly using the analyst's own underlying data would seem to have resulted in a quite different conclusion about the relative merits of these approaches from a climate change perspective.

9.10 We have similar concerns about the objectivity of the analysis of the displacement of fossil fuel by waste derived energy. Generating 1 MWh of electricity from gas and from coal incur in greenhouse gas emissions of 382 and 835 kg equivalent of CO_2 [8], respectively. Thus, for instance, proponents of EfW typically assume that it displaces coal whereas opponents assume it displaces gas [8].

10. Will MBT be cheaper?

10.1 This report has focused upon the diversity of MBT systems that are commercially available. It will therefore not come as a surprise that their **costs can vary very significantly**. There are some types of MBT than can offer both low capital costs and low operating costs and, so **MBT can be cheaper than many other options**. However, these low cost solutions have other significant limitations in terms of their environmental performance. For example, these systems have a higher propensity towards higher levels of emissions, including odours and other pollutants that could have health impacts. They also do not maximise resource recovery. Recent experience has shown that the tendered prices for **many of the more favoured MBT systems are expensive** relative to other options.

10.2 It is widely felt that MBT is a cheaper option than the thermal options being currently considered by many local authorities. Any comparison needs to be on a like-for-like basis using actual tendered prices for real-world projects and not indicative 'headline' numbers provided by salesmen in conference presentations, which, in our experience, are significantly lower than the fully burdened gate fees submitted for commercial contracts. However, tendered prices are subject to confidentiality constraints and so data cannot be put into a report like this. However we can report our general conclusions from assessing such competitive bids.

10.3 **It is normally cheaper, in capital equipment terms, to build an MBT plant than a similar capacity incinerator**, but this does not necessarily mean that the overall project economics in terms of an MBT plant will be lower. For example, the **land costs for some types of MBT can be very high**.

10.4 Proponents of MBT often point to the fact that most MBT plants do not have expensive gas cleaning systems (though they are required to do so in Germany for environmental reasons!) and they only consider the direct equipment cost and operating cost for the MBT plant itself.

10.5 In our view **it is important, when conducting an economic evaluation, to consider the overall costs, including those associated with managing the outputs**. These are normally higher for MBT than incineration and are often very much higher under current market conditions in, for example, the UK. Some outputs can command a net income but most are net cost contributors. In particular for those types of MBT that produce a fuel it is important to take into account the capital and operating costs of the fuel plant if this is integrated or the gate fee which normally has to be paid, under current market conditions, to the fuel user for accepting the material. In our experience the total costs of this type of MBT then become more expensive than a like-for-like incinerator.

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