

## Appendix 3.1: Alternative Technology Assessment

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**BRITANIACREST RECYCLING**

**WEALDEN WORKS 3Rs FACILITY**

**ALTERNATIVE TECHNOLOGIES ASSESMENT**

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## 1. INTRODUCTION

- 1.1 This report describes the main technical options available to manage and treat waste and explains how the technology choice for the applicant site has been made.
- 1.2 The Town and Country Planning (Environmental Impact Assessment) Regulations 2011 (Schedule 4, Part 2, Paragraph 4) requires that an Environmental Statement includes “An outline of the main alternatives studied by the applicant or appellant and an indication of the main reasons for his choice, taking into account the environmental effects.” The following assessment provides an outline of the alternative processes (i.e. technologies) and sites considered by Britaniacrest Recycling Ltd, along with reasons for its final choices.
- 1.3 Britaniacrest has sought advice on the technology choice from Vismundi Limited. Vismundi is an engineering and environmental consultancy established by Keith Riley. Keith has over 25 years’ experience in the development of waste management solutions and until 2012 was Managing Director of Veolia Environmental Services in the UK. He has been involved with numerous waste management projects over the years, including the flagship solution developed in Hampshire, the East Sussex PFI and Sheffield with its distributed energy scheme to name but three. Until recently, he was also Visiting Professor at Southampton University working on biogas and biological processes.
- 1.4 This assessment considers the alternative processes for the treatment of residual commercial, industrial and municipal wastes arising in the southern counties of England. The development will receive commercial, industrial and municipal wastes that have not been recycled and in the absence of such a facility will have been subjected to minimal sorting and materials recovery, and therefore would have largely been disposed of at landfill. A basic assumption of this assessment, therefore, is that landfill is not an alternative option process for these wastes. Furthermore, since the Facility will be the receiver of the wastes and will not be engaged directly with the waste producer, nor with the method of collection of the wastes, it does not consider alternative options for the collection methodologies and logistics.

## **2 BEST AVAILABLE TECHNIQUES**

- 2.1** Subject to a positive determination of the application by the Planning Authority, before the development can receive waste or be operated, it will be necessary for the operator to obtain an Environmental Permit from the Environment Agency (EA). Part of the determination of the application for the Permit by the EA will be the need for the applicant to demonstrate that the facility being proposed uses Best Available Techniques (BAT). A description of BAT can be found in <https://www.gov.uk/guidance/best-available-techniques-environmental-permits>.
- 2.2** This evaluation will not explore BAT, but whatever technology is chosen for the development, BAT will need to be demonstrated to the EA.

### 3 TECHNOLOGY OPTIONS

3.1 The choice of technology for the treatment of waste depends on the composition of the waste being treated. The applicant site will receive mixed commercial and industrial waste and some municipal waste, most of which will be a residual stream following segregation either at source or in a transfer station prior to it being transported to the site.

3.2 The technology options for treatment of waste can be categorized broadly into the following:

- Mechanical sorting and treatment
- Biological processing
- Thermal treatment
- Landfill disposal

As stated previously, since the whole purpose of the development which is the subject of this application is to divert wastes away from landfill, the landfill option is not considered further. Each of the other options will, however, be discussed in turn.

#### 3.3 Mechanical Pre-Treatment

3.3.1 Mechanical Pre-Treatment (MPT) combines several screening and mechanical sorting techniques to extract a small amount of additional recyclate from the residual waste stream. This recyclate is generally of a lower quality than that collected by source segregation and it is not intended to replace that system but to enhance recycling rates.

3.3.2 MPT configurations have developed over the years as the technology has improved - specifically in the areas of scanning and optical sorting. The configuration to be selected at the applicants site will be made with the assistance of a specialist supplier and will be state-of-the-art at the time of installation.

3.3.3 MPT is a pre-treatment process and not an end solution for dealing with the waste that cannot be recycled. Consequently, another process option is required to provide a full solution.

#### 3.4 Biological Treatment

3.4.1 **Composting** is one form of biological treatment, but is restricted to green wastes and sometimes food wastes that decompose rapidly. Composting is not considered to be an appropriate technology for the applicant site.

3.4.2 **Anaerobic Digestion (AD)** is a biological process whereby organic waste (e.g. food or green waste) is biodegraded by naturally occurring bacteria in a sealed tank in the absence of oxygen. This process produces a "biogas", which is rich in methane (a high-energy content gas), and an organic residue constituting around 85% of the solid inputs, called "digestate". The biogas is captured, and the methane cleaned and can be used in a gas engine, to produce electricity and/or heat, or compressed and used as a vehicle fuel - or even injected into the national gas grid. The digestate can potentially be used in a number of land applications (mainly agriculture) but also restoration and landscaping, depending on its nutrient content and level of stability.

3.4.3 AD is, however, restricted to organic wastes and the content of such waste in the waste streams to be treated by the applicant site will be too low to make it effective. Consequently, anaerobic digestion is not considered a suitable technology for the site.

3.4.4 **Mechanical Biological Treatment (MBT)** is a generic term for a combination of mechanical pre-treatment (similar to that described in 3.3 above) to physically separate different material fractions and a biological treatment step which may be aerobic (with oxygen present) or anaerobic (without oxygen) to biodegrade or bio-dry the organic fraction of the waste. The aerobic degradation is similar in principle to a composting degradation but when using residual waste the compost is not of sufficient quality to be reused under the UK regulatory system. Furthermore, the biological content of commercial and industrial waste is unlikely to be sufficient to support the biological step required in MBT.

### 3.5 Thermal Treatment

3.5.1 Thermal treatment of waste can be carried out using a variety of technologies that vary in:

- a) the method used to expose the waste fuel to heat - such as various types of moving grate or a variety of fluidised bed configurations; and
- b) the stoichiometry within the chamber in which the treatment is carried out – i.e. the number of atoms of oxygen available to combine with the atoms of carbon. In combustion, there are more atoms of oxygen available than atoms of carbon and the waste oxidises. In pyrolysis, and gasification there are insufficient atoms of oxygen available to combine with all the atoms of carbon and a gas called syngas is produced.

#### 3.5.2 Combustion or Incineration

Combustion of waste is often referred to as Incineration. Incineration, is however, a generic term and officially in UK regulation is even be applied to gasification and pyrolysis. Consequently, the term will not be used here with regard to technology selection.

##### **Moving Grate Combustion**

Moving grate combustion is the most common combination of process and treatment method used, and has been utilised world-wide for many years. It is a technology that is well proven as an effective method for thermal treatment of C&I as well as MSW. Combustion of waste is most commonly carried out using a moving grate which transports the waste fuel through a furnace which is designed to enable air to interact with the waste, which above its combustion temperature, will burn. The waste fuel passes through the stages of drying, pyrolysis, gasification and oxidation in one continuous phase as the waste passes down the grate. The movement of the grate ensures full combustion of the material – which means that good quality ash is produced with a low carbon content. Energy recovery is achieved by using the hot gases to convert water to steam which is then passed through a steam turbine and electricity generator set.

##### **Fluidised Bed Combustion**

Combustion plants using fluidised beds also operate world-wide, although these are most commonly found in Scandinavia and Japan, with some units operating elsewhere, including two in the UK. Experience with fluidised beds shows them to be more difficult to operate than moving grates, and therefore, a moving grate is preferred over fluidised bed.



### 3.5.3 Gasification and Pyrolysis

Sub-stoichiometric thermal processes (i.e. pyrolysis and gasification) – sometimes known as Advanced Conversion Technology or ACT - have been used as a means of thermal treatment for many years using, amongst other techniques, both moving grates and fluidised beds. In recent years, larger plants have been constructed – notably Kimijärvy II at Lahti, Finland, that processes 250,000 tpa of solid recovered fuel.

Gasification is the thermal treatment of waste in a starved air environment, producing a syngas with a high energy content, containing hydrogen and carbon monoxide.

Plasma gasification refers to the use of a plasma torch (an electron charged gas stream similar to lightning) to heat the syngas to high temperatures to crack the tars within the gas. The plasma torch uses large amounts of energy.

Pyrolysis is the thermal decomposition of the waste in the complete absence of oxygen creating a solid residue called 'char' - a carbon rich material – and pyrolysis oil. Again, the resulting gases have a high energy content, being rich in hydrogen and carbon monoxide. The energy in this syngas can then potentially be exploited as a gaseous fuel and the char can be gasified, but additional facilities are required to achieve this.

## 4 TECHNOLOGY CHOICE

- 4.1 One aspect of technology choice is consideration of European and UK policy. Notwithstanding “Brexit”, the European Waste Framework Directive is the principal legislation that applies to waste management across Europe. It supports energy recovery from residual wastes, as does the Renewables Directive. UK policy, Waste Review 2011, indicated that energy recovery is an excellent use of many wastes that cannot be recycled and could otherwise go to landfill.
- 4.2 The Waste Framework Directive introduced the concept of “Recovery” and “Disposal” and the use of the R1 efficiency formula to determine in the case of energy recovery which of these applied to a process. Any thermal process adopted for the applicant site will have an R1 of > 0.6 and therefore be classified as Recovery.
- 4.3 On the 6th January 2011, the Industrial Emissions Directive (IED) was published. This legislation brought the environmental permitting of all industrial processes under a single legislative umbrella. Whilst the transposition of the IED into English law did not change any of the environmental limits previously in place for waste management activities, any technology choice must consider compliance with the IED.
- 4.4 At the heart of the Waste Framework Directive is the Waste Management Hierarchy. Any configuration to be implemented at the applicant site will follow the principles of the waste management hierarchy – namely prevention, reuse, recycling/composting, recovery, and only then disposal. This is fundamental to the design philosophy of the site.
- 4.5 As a result of these considerations, the configuration selected is an MPT to receive and sort the raw waste, recovering where practicable materials for recovery and recycling, followed by thermal treatment to process the residual material, recover its energy content and divert away from landfill. A mechanical pre-treatment prior to combustion is technically feasible and it would enable recovery of additional metals, plastics, and inert materials.
- 4.6 In selecting the thermal treatment process, consideration was given to both gasification and combustion. Pyrolysis was eliminated primarily because there is no secondary market in the UK for neither the char nor pyrolysis oil it produces and a further process is required to utilise the syngas produced. It was felt, therefore, that pyrolysis was not an economic option that could be pursued.
- 4.7 The use of gasification was seriously considered but felt to offer no advantage under the circumstances. To date, there are still no waste fuelled gasification plants in operation in the UK (although a number are under construction), and the technology cannot be considered to be as proven as the one selected. There are no particular environmental advantages arising from the use of gasification compared to combustion and any economic advantage depends on the availability of government incentives. The economic advantage of gasification (or ACT) that has led to a massive growth in its development over recent years, has been driven primarily by the Renewables Obligation and the ability for generators to obtain a subsidy on electricity sales due to the Renewable Obligation Certificates (ROCs). The RO has now been replaced by the Contract for Difference (CfD) under Electricity Market Reform, but is an allocation following an auction process which to date has only occurred once. Whilst future auctions may occur, it is by no means certain as to when these will occur and consequently it was felt to be an unsuitable basis on which to make the technology selection.

- 4.8** The moving grate combustion thermal treatment technology selected for the applicant site was chosen due to its robust design and proven track record in dealing with the type of waste to be encountered at the Site. Currently in the UK there are around 34 moving grate combustion facilities and these are proving to be the backbone of the waste management solution in many areas of the country. The facilities operate at high efficiency and availability (reliability), and with excellent technical and environmental performance. The technology is also flexible in terms of waste characteristics ranging from commercial & industrial wastes, through MSW to Solid Recovered Fuel (SRF).

## **5 CONCLUSION**

Mechanical pre-treatment followed by thermal treatment is assessed to be the best technology choice primarily based on technical performance, reliability, and environmental performance including emissions to all environmental media. Gasification was felt to be a possible thermal treatment option, but it was dismissed primarily due to its significantly smaller operational experience base. Pyrolysis does not currently demonstrate any environmental benefit and has a significantly weaker business case.

In view of the type of material to be treated at the applicant site, alternative treatment technologies such as composting, anaerobic digester or MBT (with either of the latter processes) is not a viable option.

Mechanical pre-treatment and energy recovery using modern, state of the art technology is flexible and robust and consequently is the technology proposed for the Wealden Works 3Rs Facility. The proposed Facility will achieve “Recovery” status in accordance with the Waste Framework Directive and provide much needed renewable energy.