Energy Recovery Discussion Document: PETCO's observation of the challenges

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What is Energy Recovery?

Energy Recovery ("Recovery"), in the context of the municipal waste stream, is the process of converting waste material into energy. There are many different types of Energy Recovery technologies applicable to the municipal waste stream, ranging from low temperature landfill gas recovery, through anaerobic digestion, to high temperature incineration (often used to generate electricity), pyrolysis and gasification

In the context of plastic and packaging, Energy Recovery, in its simplest form, uses post-consumer waste as feedstock for an Energy Recovery plant, which then uses one (or more) of a number of technologies to extract the embodied energy from that material.

The Waste Hierarchy

It is recognized that recovering the energy from material is the last step in the Waste Hierarchy, and is the pre-cursor to the final option: landfill disposal. This means that before Recovery is considered, material should first be Reduced, Re-Used or Recycled.

There are many good reasons for this, but primarily it is because greater value can be extracted from the material by the steps preceding Recovery, than can be realised by extracting the energy from that material.

How Energy Recovery relates to PETCO's mandate

PETCO's mandate is currently restricted to promoting and facilitating the recycling of post-consumer PET, however as the volumes of PET grow and recycling rates increase, there is a growing need to find an end-of-life solution for the PET which is not suitable for recycling. To this

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end, we have been looking at Energy Recovery as a potential solution for some time, but unfortunately have yet to find a process, technology or business case which is viable.

The purpose of this document is to create a discussion regarding what we have found to be the challenges in finding viable solutions within the South African context. If we have stated something which is incorrect, please tell us. If you have had similar experiences as we have had, please share them with us. If you are developing an Energy Recovery technology or business and you believe that you have overcome some or all of these challenges, please get in touch with us.

In the early days of PET recycling in South Africa, there were also many challenges – some of which seemed impossible to overcome, yet 12 years later we have demonstrated that with the right vision, leadership and hard work of dedicated people, these challenges can be overcome. Setting out these challenges will hopefully bring us a step closer to realising the potential of Energy Recovery solutions in South Africa.

This discussion is however not limited solely to PET, as it applies equally to plastics and packaging.

Overcoming barriers

Overcoming these barriers will not be easy. In some cases, even just one of these will present a major challenge to the project's viability. More often than not, many are present at the same time. Hopefully this document will help in identifying and overcoming these issues early-on in a project's lifecycle.

The challenges listed here are not from any projects in particular, but they have been found to present themselves in many projects we have seen, read about or been approached. Some have been identified directly by PETCO and in some cases, by other parties.

It is important to note that many of these challenges are present in all manufacturing or processing operations, not just Energy Recovery projects. In the section below, we'll give some examples of how these challenges manifest themselves in the context of Energy Recovery operations.

Challenges

Feedstock availability

It is often taken for granted that because there is a relevantly large amount of plastic and packaging waste, that material will simply "be available". This is rarely the case. Collection systems are largely informal and supply chains are fairly fragile.

Energy Recovery competes with other end-uses for good quality feedstock and it is very rare that a plant will have suppliers lining up, looking for a place to dispose of their material.

The economics of many systems appear to assume that feedstock of a known quality and quantity will be steadily and readily supplied to the plant.

Feedstock quality

Quality is a factor that is often overlooked. Many systems seem to assume that waste is simply fed directly to the system. South Africa's waste stream is mixed and often highly contaminated with other waste. Waste, once commoditised, is often traded on a weight basis and some suppliers have been known to increase the weight of material by adding water, sand or other objects and materials.

Informal collection systems and periods of seasonal, heavy rainfall result in water being almost certainly present in the feedstock to any Energy Recovery plant. A plan for operating in such an environment is necessary.

Any Energy Recovery system does need to assume that waste received will probably include organic and non-organic fractions consisting of almost anything.

A major factor to consider is how viable the project will be when using lower quality feedstock. Many projects assume that they will receive the desired quality of feedstock, resulting in good yields, but there is rarely any sensitivity analyses conducted to see whether the project will remain viable if the plant runs for extended periods, or even completely, on low-quality feedstock.

Feedstock cost

Some systems that we have seen proposed in South Africa assume that feedstock will be delivered to the factory gate either: for free; for a very low price or; that the Energy Recovery operation will be able to charge for accepting the waste. In South Africa this may be a difficult condition to fulfil. Whatever the arrangement is, there will be a cost incurred to collect, sort and transport the waste. This will need to be accounted for somewhere, by one or more parties.

In Europe, there is a gate fee where the waste generator pays for the disposal or treatment of the waste. Furthermore, governments in the European Union have now also put an incineration tax in place to further move people away from incineration towards recycling to promote the circular economy (i.e. artificially increase the cost of disposal to incineration).

Implementing a gate fee or some other tax for accepting waste that has been traditionally been sent to municipal landfills will possibly exacerbate the illegal dumping that is occurring across many of South Africa's municipalities. Such fees would need to be considered in light of competing landfilling fees, other waste legislation and the municipalities ability to curb illegal dumping.

Availability of landfill and other alternatives

Many Energy Recovery technologies have been developed in countries where landfilling is prohibitively expensive and sometimes, physically impossible. A range of alternatives to Energy Recovery may also be present which all affect the viability of the projects. Many of these countries also operate district heating systems for which the heat from these Recovery plants is an important input. We don't have this demand for heat in South Africa, which affects the financial viability of the technology.

In South Africa, landfilling is still fairly inexpensive, albeit limited and the cost is increasing. There is very little capacity for enforcing the prevention of illegal dumping. This has the biggest impact when it comes to considering charging a gate fee at an Energy Recovery plant to accept waste, or if the plant is far away from those who may be obliged to make use of it.

Effective Process efficiency

Process efficiencies do not always take account of the electricity needed to run the operation. This is important to take account of, because in light of the current electricity regime in South Africa the operation will be buying electricity at commercial rates, off-setting any sales of electricity production which can have quite a significant effect on the economics of the operation.

Capital and replacement costs of technology

Energy Recovery technologies, like many manufacturing technologies, are usually developed outside of South Africa and often priced in Dollars or Euros. This usually makes it very expensive locally and subject to the very volatile Rand exchange rates.

Energy Recovery technologies also require very expensive air pollution control measures to reduce emissions, this requires installation of scrubbers for example – at a very high capital and operational cost.

Skills and knowledge

There is potentially a problem with Energy Recovery being able to access the necessary skills and knowledge to run such plants. South Africa does not have a history of running many commercial-scale plants. This is not to say that this is not a reason for doing so, but those planning these projects will need to account for a process of training and upskilling individuals, as the necessary experienced individuals might not be available.

Residue handling

Energy Recovery technologies have a waste or residue component of their own. There is often little mention of what the waste is and how it is to be handled.

This is potentially a significant issue, as the waste is likely to be made up of the unwanted inorganic components from the feedstock and also of the residue from the Recovery process itself. This latter residue if a derivative of petroleum products and may be hazardous or require special handling. For large plants, the volumes may be fairly significant and require a lot of consideration regarding its disposal.

There are a number of projects at present to look at utilising the bottom ash for alternative purposes, thereby reducing ash disposal to landfill.

Residues related to PET

Anecdotal evidence suggests that the residues left inside Pyrolysis reactors using PET as a feedstock are “sticky” or have a pasty, glue-like consistency which is difficult to remove and requires additional maintenance. It’s unclear whether this can be overcome by employing measures such limiting the amount for PET in the feedstock or by operating the plant at higher temperatures or whether other factors may be at play.

South Africa’s electricity pricing

In the global context, South Africa’s electricity price is relatively cheap (in Dollar terms). The problem with an environment where the cost of electricity is low is that technologies such as Energy Recovery need to price the product (e.g. electricity) at a competitive price. Even when charging a premium, the premium is anchored by the prevailing grid-supplied electricity price. Low revenue has obvious implications for the financing and repayment of Energy Recovery plants.

Waste to electricity conversion efficiencies are quite low compared to other technologies, typically around 20-30%. If the sole purpose is to produce electricity from the waste, then alternative technologies (including renewables) are likely to be more viable.

This is even more important in South Africa, where electricity-producing projects need to compete with the very low cost of coal for electricity production.

A mitigating factor here is that the price of electricity in South Africa is rising rapidly.

Supplying electricity to the National Grid

Connecting an electricity-producing plant to the National Grid is notoriously difficult, with legislation and systems not designed to readily accept independent power producers, especially smaller systems. To date, most successfully connected independent power producers seem to be relatively large installations, such as wind farms, solar farms or independent coal-fired power stations.

An Energy Recovery plant is likely to be at most a "medium" sized plant of which there aren't many examples of similar sized projects connecting to the National Grid, so there are likely to be many unknowns in doing so.

Emissions

Energy Recovery plants may have significant emissions associated with their operation and particularly harmful emissions may be present during start-up or shutdown periods. Again, there often seems to be the approach of "we'll just add scrubbers", referring to Nitrous Oxide reduction technologies and other such methods of removing harmful gases and particulates from exhaust emission, without any acknowledgement of the additional cost and reduction in system efficiency that such components have. In such cases, it is vital to acknowledge and price for these requirements. South Africa has fairly strict emissions legislation. Although it may not always be strictly enforced for a variety of reasons, an Energy Recovery project is likely to get a lot of public attention and heavy scrutiny.

Siting

Siting of Energy Recovery projects is another aspect that seems to receive very little consideration or explanation with many projects. Many factors need to be taken into account when siting projects, including (but not limited to): distance from feedstock; distance from offtake/grid connection; distance from densely populated areas (depending on emission profile), municipal by-law requirements; traffic impact etc.

Scale

Energy Recovery plants typically need to be sized to be fairly large in order to achieve viable economic operation – however this presents a problem in that vast quantities of waste need to be sourced in order to keep the plant running. This may sound like an ideal solution to the waste problem, however the very real danger is that a large plant, or too many small plants, end up undermining the recycling industries as they end up diverting waste from the recycling sector by competing for the same recyclable feedstock.

It is likely that Energy Recovery plants will need to be smaller in size than what is in operation in many parts of Europe, and sized to match the available supply of non-recyclable feedstock.

Health and Safety & Risk Management

Operating any energy plant at a small or medium scale is largely unheard of in South Africa and there is likely a lack of skills and experience in dealing with the Health and Safety & the Risk Management aspects of such installations. Sound strategies and plans for overcoming these very important issues need to be developed and included in Energy Recovery business plans.

Insurance

Obtaining insurance for the project may also prove difficult, because of the nature of these projects and a lack of case studies in South Africa. Additional time and other resources should be budgeted for to work with insurance providers to develop affordable insurance policies for the project. Addressing many of the challenges listed above will likely put a project in good stead to be insured appropriately.

The Way Forward

This document is by no means an exhaustive list of the challenges an Energy Recover project needs to overcome or take account of, but it does cover some of the more common problems we have encountered.

The answers most likely lie in collaboration of parties with the expertise and experience in dealing with these issues and identifying the suppliers and customers for such plants early on in the project lifecycle.

Building the value chain beforehand which can capitalise on opportunities for receiving waste at a low cost, supplying energy at a reasonable price and ideally negating the need to integrate into the National Grid will likely be factors that greatly improve the chance of implementing a successful project.

Given the challenges above, it may be very difficult for an Energy Recovery project to be implemented based on a business case of electricity generation, but rather as end-of-life solution for waste.

A key issue however, is that countries (like the EU member states), that have progressed very far down a high temperature Waste to Energy path, are now faced with new Circular Economy regulations that will shift the pendulum away from Energy Recovery towards recycling and the circular economy.

Very high targets for recycling are being set, to discourage landfill and incineration. This is going to have a significant impact on existing Waste-to-Energy plants in the EU (i.e. there will be an over-capacity of plants).

Do we want to go down the same path, when we could leapfrog this technology to a more recycling focus and thereby also supporting the secondary resources economy concept?

We don’t need to make the same mistakes others have made in assuming that Energy Recovery is the solution. However, given careful planning and a sound case for implementation, Energy Recovery technologies may still provide us with solutions provided the Waste Hierarchy has been followed.

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