# Advanced Integrated Solid Waste Management within South Africa – A Case Study

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ABSTRACT

The South African Government, in partnership with the German Ministry, embarked upon the implementation of an Advanced Integrated Solid Waste Management (AISWM) Programme for the Republic of South Africa.

The German Government Financial Cooperation Support Programme through KfW Bankengruppe, set out to prepare projects in pilot municipalities and disseminate knowledge and experience on Advanced Waste Treatment (AWT) and the practical application in the context of South African municipalities. As such, AISWM is considered as the coherent and sustainable application of approaches and solutions that have the effect of reducing the amount of waste that needs to be landfilled.

The Department of Environmental Affairs (DEA) coordinates the programme at the national level, with Rustenburg Local Municipality (RLM) and uMgungundlovu District Municipality (UMDM) partnering at a local level. Each of the partner municipalities receives tailored consultancy support for the preparation of AISWM projects that may be integrated into, and sustainable within, their local situation.

## 1. INTRODUCTION

Deciding how to proceed with the development of your waste management system is a challenging, complex, lengthy and ongoing process.

Municipalities in South Africa regularly receive offers from waste treatment technology suppliers. It is crucial that appropriate due diligence is undertaken on innovative, new and alternative waste management technologies.

Waste management facilities take many years to put in place, in some cases 10+ years from conception to completion, and often at each stage of the process the outcome is not certain. Project development processes cross over different political terms of office, and the municipal team involved may change. Such adjustments lead to delays in overall project coordination and implementation.

The original decision to proceed with a certain technology or facility is often challenged during the planning process, and unless the analysis and decision-making processes undertaken were robust and at an appropriate level, the whole project can very easily unravel leading to a waste of time, energy and money.

Deciding which, if any, AISWM approaches fit your situation, and what the best method is to reducing dependency on landfill, requires careful study and specialist knowledge. Every municipality needs knowledgeable people to guide them in their waste management decisions.

The intended results of the Programme are to implement successful AISWM systems in Programme municipalities; and undertake knowledge dissemination and training on best practice examples and lessons learned from the Projects, while addressing the environmental consequences of solid waste management. This includes impacts to air, water and land, through improved and sustainable operation of existing and new AWT facilities in the context of AISWM.

Knowledge dissemination will be in the form a series of knowledge products (including brochures and booklets/handbooks) to support knowledge and capacity building on the subject of AISWM across South Africa. These knowledge products shall communicate experiences gained in implementing the implementing the projects in the two partner municipalities, and add other relevant information and material from elsewhere in South Africa and internationally.

The knowledge products aim to provide clear, concise and factual information to support decision-making on advanced waste treatment, so that municipalities and their partners can plan and implement the next generation of facilities.

# 2. ADVANCED INTEGRATED SOLID WASTE MANAGEMENT

## 2.1 Overview

There are several ways to manage / treat waste. Landfilling has been considered the primary method in South Africa for many years and until recently has been the predominant method. Over the last 10-15 years, waste management options have grown to include Material Recovery Facilities (MRFs), Composting, Incineration (mainly for Hazardous and Health Care Risk Waste) and anaerobic digestion (AD).

AISWM is not a commonly used term. In this programme, AISWM is defined as the coherent and sustainable application of approaches and solutions that have the effect of reducing the amount of waste that needs to be landfilled.

Waste, by its very nature is not homogenous and is costly to collect and transport (handle). Therefore, when reviewing alternative technologies the supply of a 'quality' waste stream in terms of quantity and quality is a risk factor.

Internationally, alternative waste treatment options are generally commissioned by the private sector nonetheless are reliant on supply contracts from local government, industry and waste transport companies. Public-private-partnerships are also becoming popular and is the route, which some municipalities in South Africa follow; this includes municipalities such as the City of Cape Town, City of Johannesburg, and Drakenstein Municipality.

Although there are a plethora of tried and tested waste-to-energy / waste processing technologies in many developed countries, their applicability in South Africa is largely unknown and implementations relatively limited.

## 2.2 Drivers

The National Waste Management policy provides a framework for much needed improvements to waste management practices, but does not dictate what municipalities shall do, or what options shall be chosen. The conditions for moving up the hierarchy and away from landfill differ markedly from one local municipality to another.

One of the major driving forces towards AISWM will be the availability of permitted landfill space. Some municipalities have plenty of available permitted landfill capacity to dispose of their waste, and in close proximately to formal residential collection areas. Others are much more constrained in terms of their access to landfill, either in terms of the distance to a landfill site, the amount of permitted void space available at the local landfill, or other factors that may cause landfill to be less desirable.

Given the requirements of the *National Environmental Management Waste Act* (Act 59 of 2008), the goals and objectives of the *National Waste Management Strategy* (NWMS) and the strategic planning already undertaken by municipalities in terms of their *Integrated Waste Management Plans* and *Policies*, all municipalities in South Africa are required to reduce the quantities of waste disposed of to landfill, irrespective of remaining or potential landfill capacity.

For most municipalities, the cost of diverting waste from landfill is a key constraint, and the approach generally adopted is to prioritise recycling and composting those waste streams providing the greatest diversion for the least financial cost, including diverting builder's rubble for crushing and recycling, chipping and composting garden "green" wastes and recycling packaging wastes such as glass, paper, cardboard, plastics and metals.

As the need arises for municipalities to increase diversion rates to move closer towards national, provincial and the municipality's own diversion goals, the capital and operating costs of diversion increases. Many municipalities in South Africa are now faced with the challenge of having to move towards AISWM in order to meet their waste minimisation and diversion goals, and the selection of the best technological options in terms of viability, implementability, sustainability and affordability needs careful assessment, going forward.

# 3. TECHNOLOGIES

In broad terms, the technology options for the treatment of municipal solid waste include the following types of processes:

- Mechanical
- Biological and
- Thermal.

Technology options within each of these categories will be discussed in detail in Knowledge Product 2.

Most treatment technologies involve a combination of more than one of these processes. For example, composting of green garden waste will involve mechanical shredding as well as biological composting; the pyrolysis of mixed waste will involve mechanical pre-treatment as well as thermal degradation.

Whilst there are many configurations of plant, in general the suite of technologies covered may be classified according to the following groups as indicated in Table 1.

Table 1. Typical plant configurations

| Technology | Purpose of technology | Outline description |
|---|---|---|
| **Advanced Thermal Treatment (ATT)** | To derive energy from the waste and to reduce both volume and its biodegradability. | Processes involving heat to degrade the waste, recovering some value from its energy content.<br>Includes gasification, pyrolysis and plasma gasification. |
| **Biological treatment** | To reduce the biodegradability of the waste and its volume.<br>Typically produces a soil improver / conditioner material which may generate income / agricultural benefit.<br>Some technologies (anaerobic digestion) are also designed to recover energy from the waste. | Processes involving biological breakdown of the waste under controlled conditions.<br>Includes anaerobic digestion (AD), in-vessel composting (IVC) and open windrow composting (OWC). |
| **Mechanical Biological Treatment (MBT)** | Whilst there are a wide variety of different purposes of MBT, all configurations extract some recyclables. In addition there will always be at least one of the following other functions of the plant: to recover a fuel fraction from the waste (refuse derived fuel); to derive biogas (for AD systems) for energy recovery; to generate a compost like output; to stabilise (or partially stabilise) the waste, and reduce its volume. | Processes combine mechanical and biological elements in a range of different configurations. |
| **Mechanical Heat Treatment (MHT)** | MHT plants often have the prime aim of extracting either relatively high quality recyclables or fuel fractions (refuse derived fuel) from the waste. In addition, and dependent on the technology employed, they may: reduce the volume of the waste; derive an organic fibre for use as a raw material/substitute fuel. | Processes combine mechanical and thermal elements in a range of different configurations. |
| **Materials Recovery Facilities (MRF) - clean** | To extract recyclable material from source-separated waste in order to recover value as marketable products. | Combination of various mechanical processes to separate materials, e.g. sieving, sorting, magnets. Usually also includes some manual sorting. |
| **Materials Recovery Facilities (MRF) – dirty / residual waste** | To extract recyclable material from mixed waste streams in order to recover value as low grade recyclables.<br>To produce a fraction with good combustion properties which may be appropriate for use as a fuel (refuse derived fuel). | Combination of various mechanical processes to separate materials, e.g. shredding, sorting, magnets. |

## 4. KNOWLEDGE DISSEMINATION

The Programme will consider the technical, financial, managerial and social aspects of advanced waste treatment (AWT), which can be considered as a specific technology or facility that alters the characteristics of waste through physical, thermal, chemical, and/or biological processes either prior to, or in place of, landfill. AWT broadly includes the recycling and/or recovery elements of the waste hierarchy.

In considering the topic, the intention is to provide a comprehensive understanding of the range of technologies the possibilities and constraints associated with uptake of such approaches and technologies in South Africa, which will be disseminated in a series of 5 Knowledge Products as indicated in Table 2.

Table 2. AISWM Knowledge Products

| Knowledge product | Scope of the publication |
|---|---|
| **Introductory Guide** | This Knowledge Product defines the scope of the series, the subject of AISWM and AWT, and the framework concepts and issues surrounding the subject. It explores the rationale for AISWM/AWT, and highlights potential constraints and opportunities. |
| **Appropriate Technologies** | This Knowledge Product concentrates on the technical aspects of advanced waste treatment. It identifies and classifies the technology options, identifies technical/operational constraints and technology potential, outputs and markets. |
| **Social Considerations** | This Knowledge Product covers a range of social considerations that need to be taken into account when establishing advanced waste treatment facilities. It covers a wide range of issues from public consultation, communications and awareness, informal sector recyclers, and potentials for job creation. |
| **Sustainable Financing** | This Knowledge Product addresses concepts, experiences and practices to guide sustainable financing. It covers different approaches and possibilities for financing the construction, operation and re-financing of advanced waste treatment facilities. |
| **Operator Models** | This Knowledge Product provides guidance on the management and contracting arrangements for advanced waste treatment facilities and services. It identifies and classifies the different contractual approaches relevant to advanced waste treatment. |

## 5. CONCLUSION

### 5.1 Constraints

South Africa has the advantage of learning from and building upon established and emerging global best practices in the sector. This provides an opportunity for the most appropriate advanced technologies for the South African context and specific municipalities and industries to be selected from the global market.

South Africa is at an early stage of implementing AISWM. As a result, constraints and opportunities for establishing new AISWM solutions are imminent. Constraints may include;

- High Costs
- Long term contracts
- Community concerns & uncertainty
- Financing
- Competing methods of managing waste streams
- Vulnerable markets for outputs/products and
- Security of supply of input materials.

### 5.2 Opportunities

The Department of Environmental Affairs, through recent national legislation, has set the requirements and standards in South Africa for the implementation of sound waste management practices for ensuring environmental sustainability. Opportunities that are expected to arise from sound waste management practices include:

- Reduction in waste requiring landfilling, therefore minimising the need for expensive void space and reducing environmental impacts associated with landfilling
- Recycling of materials that in turn will lead to less demand on the country's natural resources with associated improved carbon impact.

#### 5.2.1 The Environmental Dimension

Waste management practices that include sound organic waste management will create opportunities for growing compost production for soil enhancement and for creating energy-from-waste which will reduce the demand for energy-from-coal, thus re-aligning with South Africa's commitment towards growing its usage of "green" energy.

Reduction in waste to landfill will reduce the environmental risk of potential pollution of the natural environment through less leachate and landfill gases being generated.

With new landfills needing to be developed further away from the sources of generation, AISWM has the potential to significantly reduce long-haul transportation costs and the resulting carbon footprint.

#### 5.2.2 The Socio-Economic Dimension

South Africa is a country confronted with the challenges of building a new democracy, where previous inequalities have led to large sectors of the population being unemployed. Sound waste management practises provide opportunities for the following enhanced socio-economic betterment:

- Providing a basic human right to clean and healthy living conditions.
- Growth of the country's infant recycling industry that will lead to the creation of job opportunities and improve South Africa's socio-economic situation.
- The growth of compost production from organic wastes can improve soils in marginal agricultural areas, which has obvious socio-economic benefits for South Africa given the overwhelming need for viable farming land and food security.

Further, the production of energy from waste, as experienced in the recent national drive towards wind and solar energy production, will lead to the creation of job opportunities and improve South Africa's socio-economic situation.

### 5.3 Decisive Factors

There are many decisive factors that will influence the course of action, some of which include; technical, contractual, financial and regulatory factors.

Given technology changes, the types and quantities of waste that are being generated by households, commerce, industry and institutions, change, likewise. There is no one-size-fits-all solution to managing wastes. Different approaches always need to be adapted into their setting, meaning consideration of facilities of different scales of operation, working within different market conditions, and seeking to meet the needs of our diverse communities across the nation.

Conclusively, a select number of varied but common issues are expected to drive the next stage of AISWM development: Over time, it will become even more difficult to locate, construct and operate new landfill sites. The costs of landfill will continue to increase over time, especially if the environmental externalities of landfill are brought into waste management policy (e.g. via a landfill tax); placing waste in a landfill may be seen as storing up future costs and environmental liabilities. A new generation of environmentally educated South Africans will increasingly demand more attention to diverting materials from landfill. Finding new approaches to managing waste will become a political as well as practical imperative.

Policy is driving forward a gradual shift away from dependency on landfill. The waste management hierarchy is at the centre of policy, and eventually will take effect in shaping the practical systems in place on the ground.

As policy takes effect, a thriving new market for advanced waste treatment will emerge. This shift will mature with time alongside the buy-in and support from financial markets and Business, respectively.

## ACKNOWLEDGEMENTS

The authors hereby acknowledge input provided by the following institutions:

Dr Jenitha Badul, Senior Policy Advisor – Greening Programmes and Fund of the National Department of Environmental Affairs,

Bernhard Schenk, Senior Engineer – Climate and Environment, KfW German Development Bank, and

Ms Julia Crause, Infrastructure Support for Southern Africa, KfW German Development Bank.

## REFERENCES

Department of Environmental Affairs. 2008. *National Environmental Management: Waste Act* (No. 59 of 2008). Department of Environmental Affairs, Pretoria

DEA, 2011. *National Waste Management Strategy*. Pretoria, Government Printer