Scenarios and Lessons Learnt in the Diversion of Municipal Solid Waste Away from Landfills in 6 South African Municipalities

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ABSTRACT

The Government of South Africa, in partnership with the German Government, has embarked upon the Waste Management Near-Term Priority Climate Change Flagship Programme, which includes identifying areas for strategic interventions that advance the objectives of both the National Climate Change Response Policy and the National Waste Management Strategy (2011).

The appointment is for the development of 6 (selected) Municipal Strategies for diversion from landfill. This includes identifying areas for strategic interventions that advance the objectives of both the National Climate Change Response Policy and the National Waste Management Strategy.

Diversion of organic waste and green waste away from landfills is one key approach to mitigating climate change in the waste sector. Other alternatives do also exist such as recycling of paper, plastics, glass and other such recyclable materials. Recycling goes a long way in mitigating climate change due to the fact that natural resources are saved in the process. This said, proper implementation of the waste hierarchy supports climate change response, waste management and sustainable development simultaneously.

There is a need to scale up existing response programmes but also to consider introducing alternative waste management options or combination of technologies to maximise the benefits from improved waste management systems to climate change.

The waste sector in South Africa is estimated to be worth R15.3 billion per annum (DST, 2013). However, the resulting market potential is currently not being used: the waste sector is characterized by approximately 90% of all waste being disposed of at landfills (Lazarus et al, 1997). The resource value of the waste is estimated to be R25.2 billion per annum (DST, 2014). Diverting all waste from landfill therefore has the potential to unlock R17 billion per annum. 10% recycling unlocked R8.2 billion/annum.

This project offers an opportunity to make a step change in the development of Integrated Solid Waste Management (ISWM) practices in the partner municipalities.

1. INTRODUCTION

The Sections below are key elements of the Project which formulated the approach and some main aspects of the Project, such as:

1. Stages of the project
2. Climate change (and emissions mitigation)
3. Criteria identified that offers greater opportunity for beneficiation
4. Decision making tool
5. Lessons Learnt (to allow future projects to benefit)

Other elements of the Project were to identify major and minor risks. These are project specific and are available from the author.

2. STAGES OF THE PROJECT

The most important element followed, during the stages of the Project, by the Project Team, was to allow for extensive engagement, at local level, and national level, to allow full debate, to agree on criteria that would be essential to any Project achieving sustainability.

Stages of the Project, in brief, were:

1. Project Inception Workshop;
2. Field investigation;
3. Local Municipal staff and Team introduction and knowledge sharing;
4. IDP, IWMP review;
5. Status Quo analysis;
6. Waste Characterisation investigation (site work and literature);
7. Project review workshop;
8. Further on-site (local level) debate and engagement on possible scenarios;
9. Additional site investigatory work;
10. Scenario formulation and evaluation;
11. Further on-site (local level) debate and engagement on possible scenarios;
12. Project Team engagement on legislative and funding mechanisms;
13. Preferred Project Plan
14. Lessons Learnt review
15. Over-arching Preferred Project Workshop and engagement.
16. Way Forward.

3. CLIMATE CHANGE

In this Project, greenhouse gas (GHG) reduction was the difference between the baseline and each scenario in turn. The assessment took into account only the methane generation at the landfill and the mitigation impact resulting from the diversion of waste from the landfill.

Emission reductions resulting from the replacement of virgin materials with recyclable materials or from the generation of energy from waste, where waste is considered as a renewable energy resource, was not considered in the assessment. Likewise, process emissions from the different treatment options were also not dealt with, due to insufficient data.

The IPCC Waste Model was used to compare previous evaluations with current evaluations as well as to align with international best practice. The IPCC Waste model has been shown to provide 'fair results compared to field measurements' in other studies (e.g. Wangyao *et al*., 2010), taking into account the climatic conditions associated with the area as well as the variation of degradation rates between seasons.

"First Order Decay" method, as was used in the Status Quo Report. This method takes into consideration long-term methane generated at the landfill, using the following equations (Pipatti *et al*., 2006):

$$CH_4 \text{ generated}_Y = DDOC_m \text{ decomp}_Y \times F \times 16/12$$

The Project Formulation Report (JG Afrika/RWA, *Scenario Formulation and Evaluation Report*, 2016) contains the outcomes of the values and the default values used. An example of such analysis is found below in the Figure.

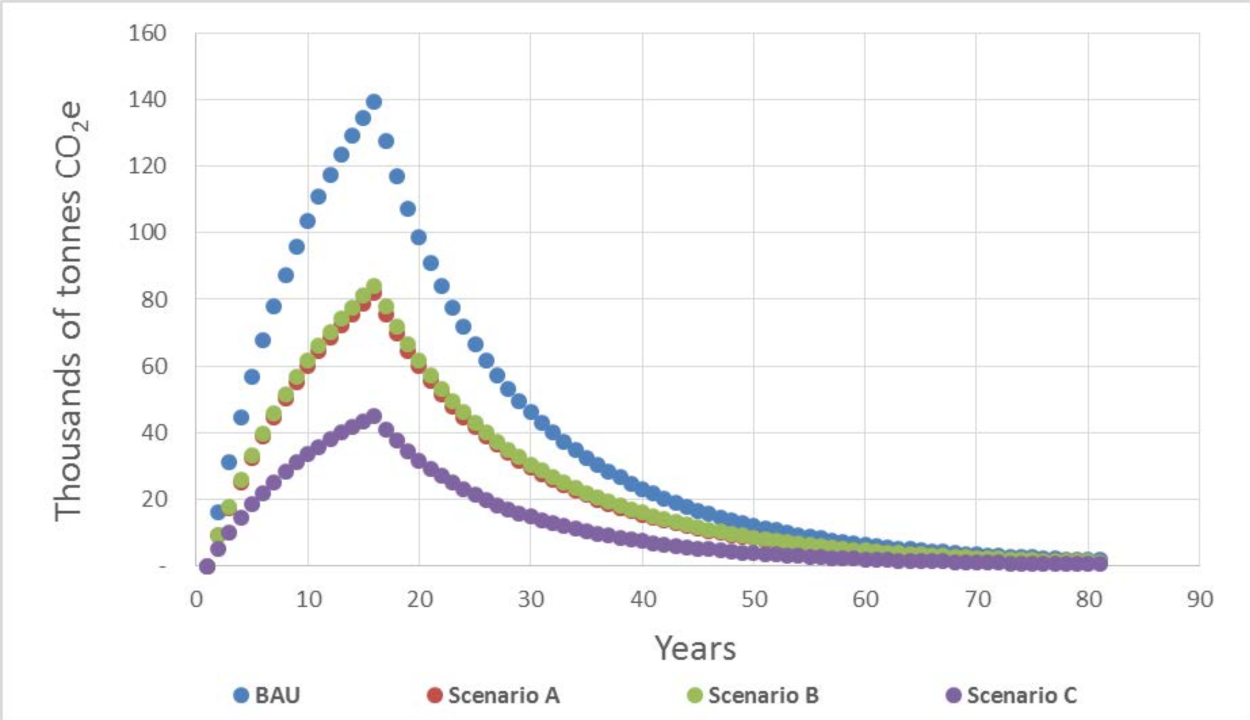

Figure 1: Tonnes CO_2e generated over 80 year period at landfill

Another key element for analysis is the comparative analysis between financial modelling outcomes and the emission avoidance figures. An example of such analysis is shown below.

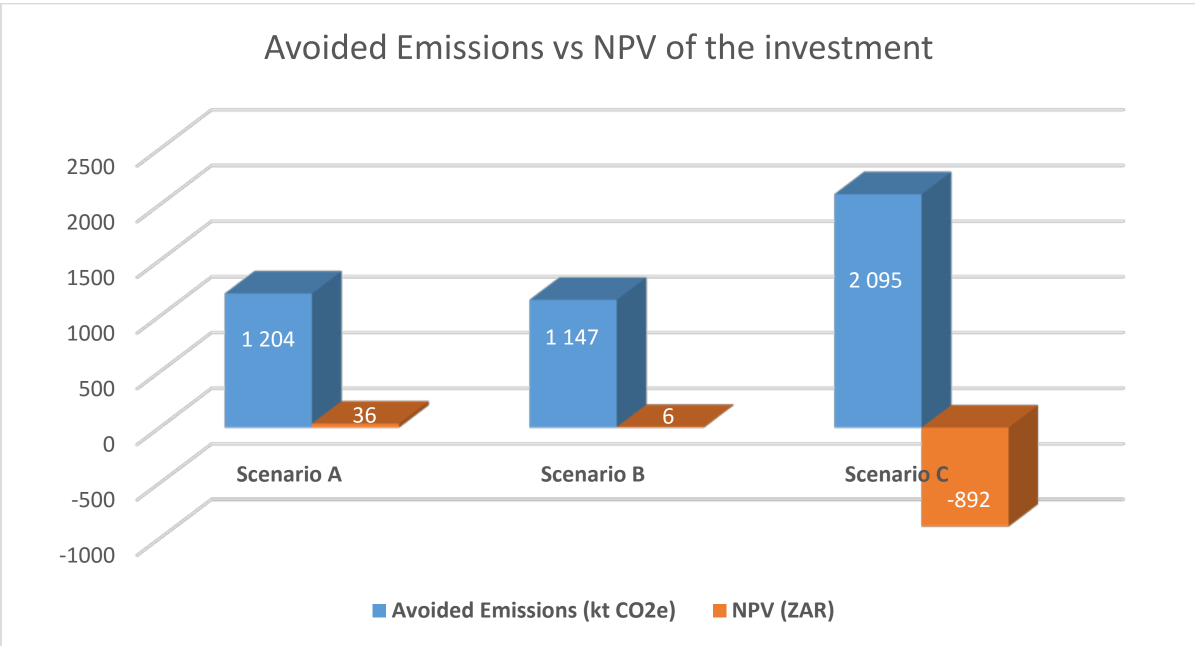

Figure 2. Avoided emissions vs NPV of the investment

4. CRITERIA IDENTIFIED THAT OFFERS GREATER OPPORTUNITY FOR BENEFICIATION

After extensive debate, certain criteria were identified as items of major importance, to allow greater opportunity for any waste-beneficiation project to achieve sustainability and viability. These criteria can be summarised as follows:

1. All Preferred Projects will have an effect on the greater waste material system.
2. Geography of the waste material “catchment area”;
3. Climate;
4. Social culture of the area;
5. Industry maturity for selected waste materials as a product (local level, district level, provincial level, national level);
6. Feedstock (waste) quantum and variability (in quantity);
7. Feedstock character and variability (in character);
8. Climate Change mitigation potential;
9. Emission avoidance potential;
10. Municipal land;
11. Existing civil, transportation and electrical infrastructure;
12. Existing project (to avoid duplication or derailing planning for viable projects);
13. Budget and effects on gate fee for any potential projects;
14. Staffing and institutional arrangements;
15. Procurement processes;
16. Regulatory framework;
17. Capital and operating expenses of relevant departments;
18. Effects on tariffs and rates for any changes;
19. Other (contained in Project Reports).

5. DECISION MAKING TOOL

A multi-step method was used to formulate Scenarios and aide decision making. These were:

1. A total of 40 generic interventions were developed and ranked according to the National Waste Management Strategy Hierarchy. A comparison between the interventions using the selected technical, environmental, financial, legal and institutional criteria was done and used to determine a record of “soft interventions” that would be prerequisites for each intervention to be successful.
2. Three sets of input data were used to determine the total quantity and character of waste. Three main waste streams were focused on, namely: (1) Organics – greens, (2) organics – food waste, and (3) packaging waste.
3. After specific waste streams were identified, and the geographic and climate aspects taken into consideration, generic interventions were selected for each municipality. This was done by taking a critical look at the waste stream composition (Sub-section 2.1.2), the output/product requirements and the key driving factors such as affordability, institutional capacity and feasibility amongst others.
4. System interventions were then formulated to address a specific identified waste stream, such as organic food waste, organic greens and packaging. These system interventions also highlight the inter-dependencies between each individual intervention, which is critical.
5. System interventions for all three waste streams were then linked together by the municipal managers and officials, in order to formulate a set of scenarios for the municipality.

One innovative approach was the use of cards to show SYSTEM intervention approaches, suited to local conditions.

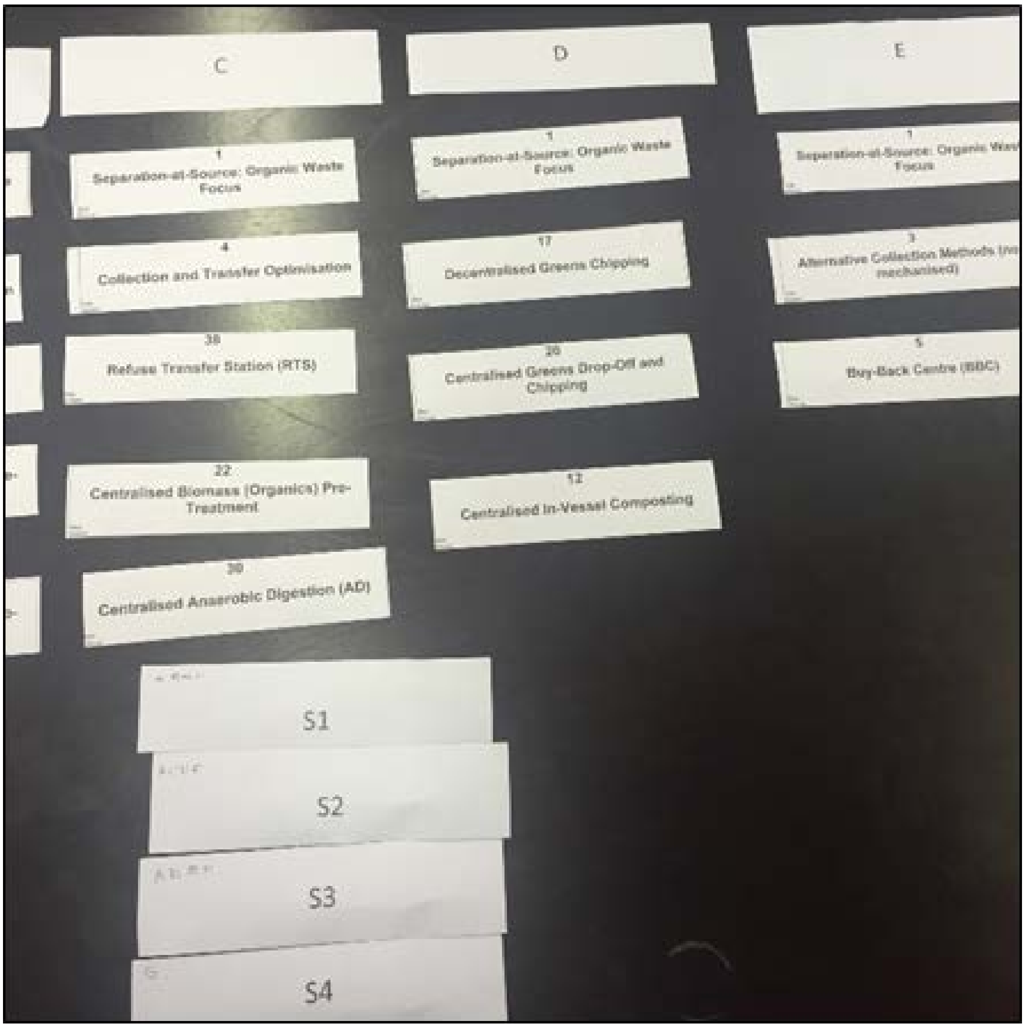

Photo 1: Key cards for decision making

In order to highlight a “preferred” scenario from the five comparative scenario evaluations above, the unique Triple ‘A’ Consolidated Evaluation Method was used. This method focuses on three key criteria of an AISWM scenario or project, namely: (1) how appropriate it is, (2) whether it is applicable, and (3) if it is affordable.

6. LESSONS LEARNT

During the project, a key element was to note lessons that can be learnt from the Project Team, to allow future such projects to benefit.

Some of the lessons can be seen below.

Table 1: A few key Lessons Learnt

Lesson Learnt	**Mitigation, solution**
Learnership	Learning opportunities must be identified in collaboration with universities
Learnership institutions & Municipalities	Facilitating closer working relationships between universities and municipalities.
Empowerment	Interns and youth employed by the municipalities must preferably be assigned to the project to maximise the capacity building benefit for the individual and the municipality
Council Approval	TOR should take into account Municipal approvals, such as reporting, presentation to Municipal Manager and CFO, ultimately to obtain Council Resolution.

Lesson Learnt	**Mitigation, solution**
Waste tonnage data	Susceptible to weighbridge operations and Municipality collecting and reporting on waste quantum.
Bottle necks – legislation	EIA process Waste licence applications Atmospheric emission licence applications Public participation as part of the EIA process
Procurement	Long-term versus short-term contracts need to be demystified and considered a real opportunity for Contracts with external parties.
Municipal champion/ drivers	Many Municipalities have limited resources to take over the planning and implementation of the project(s) as a representative of the local municipality.
Emission avoidance modelling	No common modelling software appears to exist which is able to encompass all aspects of a solid waste =-project-intervention.
Emission avoidance modelling	Base data is lacking at a local municipal level.
Change in institutional matters	Labour issues are an important risk to note
Consortiums	Bringing a consortium instead of a single consulting team was very beneficial to the project and this is how it should be done in future
MRV	Lack of base data and use of IPCC model is best suited to the project objectives, but still does not represent the full story of collection, avoidance of raw material use, etc.

7. CONCLUSION

The above findings are key knowledge sharing elements of the Project, that aid future such Projects and local authorities identify waste diversion opportunities.

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