MAKING CENTS OF COMPOSTING

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Revised Version

A Municipal Savings Model for Diverting Organic Waste from Landfill

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Produced by groundWork, the Durban University of Technology, and LUMEC as part of the Durban Zero Waste Project

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Abbreviations

Abbreviation	Description
BCR	Benefit-Cost Ratio
BSMTAU	Business Support, Markets, Tourism and Agri-Business Unit (eThekwini Municipality)
CAP	Climate Action Plan
CBA	Cost-Benefit Analysis
CO_2e	Carbon Dioxide Equivalent
CPI	Consumer Price Index (Inflation)
CSW	Cleansing and Solid Waste Unit (eThekwini Municipality)
DUT	Durban University of Technology
DZW	Durban Zero Waste (Project)
EMM	Early Morning Market
GAIA	Global Alliance for Incineration Alternatives
GHG	Greenhouse Gas
MSW	Municipal Solid Waste
NPV	Net Present Value
PRC	Parks, Recreation and Culture Unit (eThekwini Municipality)
QS	Quantity Surveyors
S@S	Separation at Source
SAPIA	South African Petroleum Industry Association
SARB	South African Reserve Bank
SAWPA	South African Waste Pickers Association
SARS	South African Revenue Service
SSA	Sub-Saharan Africa
UFC	Urban Futures Centre (Durban University of Technology)

Executive Summary

Globally the waste sector is a significant contributor to greenhouse gas (GHG) emissions. One of the more significant impacts of landfilling organic waste is its contribution to methane gas, which, over a 20-year lifespan, has over 82.5 times the warming potential of carbon dioxide (GAIA, 2022). According to the State of the Waste Report, an estimated 6.5 million tonnes of food and garden waste was generated in South Africa in 2017 (DEA, 2018), much of which is sent to landfill.

In addition to the emission of methane and other GHGs, landfills also generate multiple negative public health impacts and other externalities (Goa, 2017; Scarlat, 2015). It is also a costly management approach requiring increasingly scarce land and airspace in urban areas. Due to these negative impacts, the global focus has shifted urgently towards more sustainable, alternative approaches to managing organic waste.

Municipalities can derive numerous benefits from diverting organic waste into alternative treatment methods, such as small-scale, decentralised composting and anaerobic digestion (to produce biogas).

This Cost-Benefit Analysis (CBA) report was commissioned to determine if there is a net benefit or cost to the eThekwini Municipality from diverting food and garden waste from landfill into small-scale compost production operations.

An initial CBA was done on a first pilot project that diverted organic waste (fruit and vegetables) from the municipal-run Early Morning Market (EMM) in Warwick Junction and composted this along with garden waste at the Durban Botanic Gardens. This was then scaled up to a second project, where fruit and vegetable waste from the Bangladesh Market in Chatsworth was combined with garden waste from municipal park's District 8 to make compost at a site called Depot 6 in Queensburgh.

This report presents the combined results of both projects in order to determine the impact of scaling-up small-scale decentralised composting projects at a municipal level.

Given the success of both projects, significant potential exists to scale-up and divert all the food waste from the EMM and Bangladesh Market into full-scale composting operations.

Drawing on research data collected over four years (2021 to 2024), this report illustrates the feasibility of small municipal-run decentralised models that compost organic waste within close proximity from where it is discarded.

The data used within this CBA include a baseline assessment and waste categorisation study undertaken in the EMM and Bangladesh Market. The study estimated that 416 tonnes of food waste is generated at the markets per year (i.e., fruit and vegetables) which are being sent to landfill. When combined with garden waste (321 tonnes) and mature compost from the previous production cycle (154 tonnes), this can generate 296 tonnes of compost per year, or just over one tonne of compost per operational day.

For the two projects, only some of this waste was incrementally diverted for composting. This has ensured a steady flow of organic feedstock from the markets, and from the gardens, to produce a high-quality, rich compost for use by the municipal Parks, Recreation and Culture (PRC) Unit. Data has been captured throughout the project processes on volumes, feedstock inputs and compost outputs, as well as technical data on the air temperature and humidity, soil moisture content and temperature, and level of rainfall, etc.

In order to develop a CBA for the diversion of the entire 416 tonnes of food waste, all the costs and benefits of the composting projects were identified for three scenarios and quantified for the status quo (i.e., sending all food waste to landfill) and for the alternative (i.e., diverting food waste to produce compost), and these costs and benefits were then projected over a 10-year period. The costs were then subtracted from the benefits to calculate either the net benefit or net cost, which is then discounted using an appropriate rate to determine the net present value (NPV).

Lastly, a sensitivity analysis was done to test the impact of some key variables on the NPV in each of the three scenarios presented.

The CBA model indicates that due to the substantial costs associated with sending waste to landfill in the eThekwini Municipality (incurred from limited landfill space, long transportation distances, etc.) and the savings generated from diverting waste and creating compost, this project creates a net positive benefit to the municipality. An NPV of over R1 indicates that the project is worth pursuing, and this CBA shows an NPV of R14.1 million over 10 years.

Additionally, there are numerous other positive impacts that are created through this project, such as creation of new, green employment opportunities, GHG emission reductions from compost production (especially methane), reduced transport costs, and the potential reinvestment of savings for the municipal Business Support, Tourism, Markets and Agribusiness Unit (BSTMAU) into the EMM and Bangladesh Market infrastructure, which will help improve the working conditions for market traders and vendors.

As a recommendation from this study, scaling up of the current organic waste to compost model should be supported by the eThekwini Municipality.

Further to this, it is highly likely that other projects of a similar nature would be equally as viable within the municipality, and as such, the expansion of this model to other fresh produce markets should be investigated.

Ultimately this CBA indicates that municipal-led, small-scale decentralised composting sites hold potential to create local jobs across the city, meet Climate Action Plan (CAP) goals through reducing methane and other negative externalities created from landfilling, and produce rich compost for growing plants and food in the city. The impacts are however far wider in reality and address a range of priority city policies and plans.

Creating decentralised sites where new, green jobs are created helps address spatial inequalities that exist, while reduced demand for waste management can allow these services to be reallocated to areas that are currently under-serviced.

Further, this model acts as an example of how transversal governance can be achieved with the municipality to address shared challenges, while also providing a strong foundation for further education around zero waste principles and decentralised approaches towards organic waste management.

Summary of Key Findings

1 Estimated food waste generated at fresh produce markets per annum

330 tonnes
EARLY MORNING MARKET

86 tonnes
BANGLADESH MARKET

Potential to be diverted from landfill and combined with garden waste to produce compost at the Botanic Gardens and Depot 6 in Chatsworth.

2 Estimated organic waste diverted from landfill

416 tonnes
FOOD WASTE

321 tonnes
GARDEN WASTE

737 tonnes
TOTAL WASTE

3 Expected compost produced per annum

296 tonnes per year

4 Small capital investment required

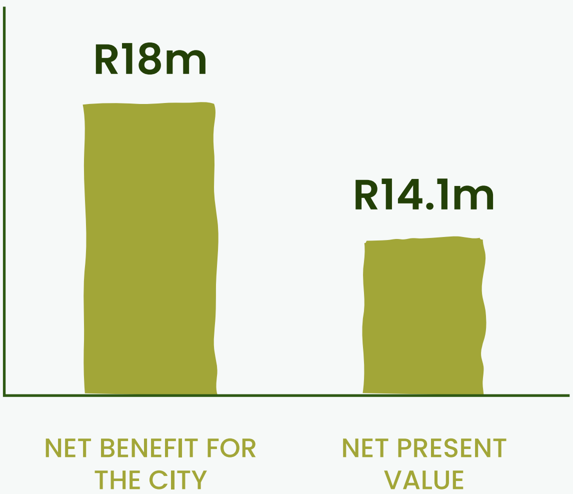
R1.6m machinery and equipment

R550k site preparation

5 Cost-benefit analysis results

a. Diverting waste from landfill into composting can generate an overall net benefit for the city of R18 million over a 10-year period, with a Net Present Value (NPV) of R14.1 million.

b. In comparison, when sending this waste to landfill, this is a net cost to the City of R32 million over a 10-year period, with an NPV of -R25.2 million.



6 Impacts (per annum)

R1,3m Potential saved in waste disposal fees for the Business Support and Parks unit

R1,3m Potential saved in landfill and airspace costs for the Waste Management unit

R300,000 Potential saved for the Parks unit in avoiding compost purchases

7 Full-time composting jobs

4 Part-time composting jobs

622 Tonnes of Carbon Dioxide Equivalent (CO_2e) potentially avoided from being emitted, resulting in a financial saving of **R147 000** (based on the current carbon tax rate)

7 Other benefits

- Creates compost that replenishes depleted soils and supports food production
- Increases education around organic waste management, zero waste models and climate change mitigation
- Creates local, green jobs that address spatial inequalities
- Creates a strong model for transversal governance in creating circular economy models in the city

Small-scale, decentralised approaches to organic waste management have positive financial, economic, social, environment, educational and institutional impacts for cities!

Introduction

SECTION 1

1.1 Background

The Durban Zero Waste (DZW) project started in early 2021 and is being implemented by groundWork and the Durban University of Technology (DUT[1]). The initial aim of the project was to co-create a zero waste case study, focussing on the informal markets in Durban's Warwick Junction, while the goal was to create an easy to replicate, zero waste to landfill case study for large informal markets commonly found in Africa.

After successful implementation of a composting pilot project at the Botanic Gardens using food waste from the Early Morning Market (EMM) from 2022 to 2023, a second project was implemented in 2024 at Depot 6 in Queensburgh using food waste from the Bangladesh Market in Chatsworth. The background to each of the projects is presented below.

1.1.1 Project One (Early Morning Market)

Within the first year of the project (2021), research and data collection was done to identify pilot projects. One such project identified was to undertake a baseline assessment of the EMM to collect data on the types and volumes of waste being generated.

Firstly, a survey was completed with 166 traders, which identified information such as that 78% of the products sold were organics (fruit, vegetables, etc.), that 88% of traders were not sorting their waste, and that 92% of the waste goes into the allocated wheelie bins in the market.

These bins were being collected by the Cleansing and Solid Waste Unit (CSW) to be sent to landfill.

In order to get more refined data on this waste, the team undertook a waste categorisation assessment where bins were weighed over a period of 16 days, following which a more granular waste audit process was done on 10 of the bins each day. Using this data, it was estimated that on average, a total of 393 tonnes of waste was generated at the EMM per year that was being sent to landfill, with 84.1% of it being organic waste (i.e., fruit and vegetables).

Given that the aim of the project is to identify zero waste to landfill solutions, the next step for the DZW team was to identify potential opportunities to divert this waste from landfill. Using a 2km radius, the Botanic Gardens (which is only 1.5km from the EMM) was identified as a potential location which could be considered for a composting pilot site.

[1] In the first pilot phase of the project (until end 2023), Asiye eTafuleni were a key implementing partner.

Figure 1: Images from the waste categorisation assessment

After securing support from the PRC Unit for the use of the Botanic Gardens site, the phase one pilot process was initiated between 28 June and 8 November 2022. During this initial phase, one 240-litre wheelie bin of food waste was collected from the EMM per week and combined with green and brown garden waste from the Botanic Gardens to create 16 compost heaps.

Thereafter, on 21 November 2022, the team initiated phase two, a scale up of the initial pilot, whereby a one-tonne bakkie was used to collect EMM waste to create a single large compost windrow at the Botanic Gardens. Based on learnings from the first two phases, phase three was initiated on 15 March 2023, which involved the collection of food waste twice a week and the construction of 12 windrows, along with relevant drainage to capture leachate run-off. Compost is produced and matured in rotation over a three-month period. Figure 1 provides a snapshot of the three phases.

PHASE ONE
28 Jun - 8 Nov 2022
1 x 240l wheelie bin
1 per week
16 compost heaps

PHASE TWO
21 Nov 2022
1 tonne bakkie
Once-off
Single windrow

PHASE THREE
15 Mar 2023 - present*
4 tonne truck
2 per week
12 windrows

*As of April 2025, CSW collects EMM organics every second week for composting.

Figure 2: Timeframes of each phase

Throughout all of these phases, research was conducted on the composition of each compost heap. On a weekly basis, technical data was collected on the air temperature and humidity, soil moisture content and temperature, and level of rainfall, etc.

Additionally, the quality of the compost was assessed through sending samples for full nutrient testing and microbial analysis, while the team also conducted a series of pot trials on compost samples to compare the growth rates of different species of plants in the project compost, as compared to other commercial compost varieties.

The tests show that the project compost is rich in nutrients and full of diverse life, and that plants grown in this compost outperform the growth of plants cultivated in the commercial compost samples the team tested against.

Figure 3: Phase One - Pilot compost heaps being tested by a DZW team member

Figure 4: Phase Two - The DZW team after setting up the first scaled-up windrow

Figure 5: Phase Three - Setting up 12 windrows

Given the success of the initial pilot project in creating a high-quality compost product, the DZW team identified significant potential to scale-up even further and divert a more substantial amount of food waste from the EMM into compost production. However, to do this would require the support and buy-in from various municipal departments, and the viability of the proposed project would need to first be determined.

As such, the DZW team approached Lumec to undertake a CBA, which identified both the economic and environmental costs and benefits of the pilot project and determined the viability if all food waste from the EMM is diverted into a full-scale composting operation. The report from the first pilot can be **found here**.

1.1.2 Project Two (Bangladesh Market)

Based on the success of the first project, in June 2024, the project team began planning for a second project to divert organic waste from a second municipal market, the Bangladesh Market in Chatsworth. A PRC site was identified nearby in Queensburgh (Depot 6) for composting, which is a 14km round trip from the market.

In preparation for the scale-up of the model to the second site, the team engaged in intensive qualitative and quantitative research in the market space, similar to the methodology employed to research and plan in the EMM. This comprised ethnographic research, the administration of a trader survey, and a granular audit of the waste generated at the Bangladesh Market.

Ethnographic research was conducted at the market in June and July 2024. During this time, project researchers spent time in the market observing trade and waste management practices, and engaging in conversations with traders, market cleaners and other actors. The researchers captured photographs and wrote up detailed fieldnotes.

This was useful in understanding current waste management practices in the market, the flows and types of waste generated, as well as any existing efforts by different stakeholders to recycle or reuse organic waste. Additionally, this allowed the team to get to know the traders, the trader committee and cleaners, all of whom are important stakeholders for implementation.

The general sentiments shared by these stakeholders were that there was initial buy-in for the project. There was also a general concern for the environment, although the link between waste and climate was less understood. The team identified that some traders are also farmers, and some are already composting.

Some traders also sell their produce at other markets during the rest of the week (since the Bangladesh Market only operates on Fridays and Saturdays) or sell at shops that they have agreements with; this ensures less wastage. Most of the traders have been selling for decades (some for over 40 years).

In relation to the waste generated, the team identified that waste pickers visit the bin area frequently to recover recyclables as well as edible chicken and fish, but they are often chased away by market security.

Finally, there is a lot of abattoir waste that is currently not being separated. Large amounts of feathers and innards are generated weekly, and these end up in the bins as well as the CSW skip that is provided for this waste stream.

Whilst the ethnographies were underway, the research team replicated the trader survey that was undertaken in the EMM project.

Over June and July 2024, 150 traders were surveyed out of a total of 220, representing a 68% response rate.

This survey was useful as the team was able to meet individual traders, explain the project and answer questions, discuss the importance of zero waste, composting, separation at source (S@S), and triangulate the data obtained from the ethnographies above.

The results of the survey indicated that 63% of goods sold in the market are fruit and vegetables and a further 7% are meat products. In addition, traders sell household items, clothing, make-up and hair dye, DVDs and CDs, spices and cooked food. Traders produce a varying amount of waste; 29 traders (19%) indicated that they produce no waste, or very little waste, and these traders were mostly those selling non-organic items. Almost 80% of traders noted that they do not do any separation of waste for reuse or recycling, with only 21% noting that they do. Of those who did some separation, 14 traders noted that they keep cardboard aside and give this to waste pickers or customers that want this.

Traders were also asked if any waste they generated was still edible and, if so, what they do with this food.

Twenty-seven traders (18%) explained that they either give this food away to waste pickers in the market or anyone who wants it, that they or their assistants take this food home to eat it themselves, or they give it to their neighbours.

Finally, a granular audit of the Bangladesh Market waste was conducted in August 2024 over eight days, on both Fridays and Saturdays (the two days of the week that the market operates). Members of the South African Waste Pickers Association (SAWPA) joined the team to advise and assist. Staff from CSW also participated.

During this period, all bins were counted and weighed. In addition, on every data collection day, 10 bins were sampled and audited to identify and weigh the specific waste streams contained in each bin. This resulted in an estimated tonnage of 94.4 tonnes of waste being generated at the market per year of which 90.6% was food waste (85.5 tonnes).

Figure 6: Images from the granular audit

Following the data collection process, a meeting was set with the municipal partners to present the research findings and discuss the next steps. This included the preparation required to get the identified composting site in Queensburgh (Depot 6) ready, and to operationalise the model and promote S@S in the Bangladesh Market. To aid the latter, the project team, accompanied by BSMTAU officials, met the trader committee, market cleaners, and market security guards to go through implementation processes and timeframes to get buy-in.

The team also involved the Zero Waste Champions from the EMM, as well as creative performers, who visited the Bangladesh Market to engage in activations aimed at advocating for S@S. The cleaners from the Bangladesh Market and members of the trader committee were also later invited to visit the Botanic Gardens site and attend joint workshops with stakeholders from the EMM to reflect on the project implementation and to plan for 2025.

Involving stakeholders in implementation, and activating the market through dance and theatre, has been successful in fostering ownership of the work and in creating space for conversations around zero waste and S@S in a way that resonates with the market community.

The collection of organic waste from the Bangladesh Market then started on 30 September 2024, and the first windrow was constructed on the new site at Depot 6. The team has since been collecting increasing quantities of organic waste over the first months of implementation.

On 27 January 2025, the team packed up their first windrow which was mature and ready for collection and use by the PRC Unit. This first windrow contained 752kg of rich compost. Collections will now happen weekly from this site, as is the case with the Botanic Gardens site.

1.2. Context and Rationale

1.2.1 Organic Waste as a Challenge

Within Sub-Saharan Africa (SSA), the organic fraction of municipal solid waste comprises between 43% (Kaza, 2018) and 57% (UNEP, 2018) of total Municipal Solid Waste (MSW) generated. This is significantly greater than any other waste stream. In South Africa, organic waste contributes almost 20 million tonnes, or 35% of total general waste generated (DEA, 2018) – this includes garden waste, food waste, and wood waste.

Most organic waste, along with other waste streams, is either openly dumped and burned (69% of total waste in SSA) or sent to landfill (24% of solid waste in SSA) (Kaza, 2018). In South Africa, an estimated 6.5 million tonnes of food and garden waste were generated in 2017 (DEA, 2018), and most of this is being sent to landfill.

Landfilling of waste has several disadvantages including large land requirements, GHG emissions (especially methane), surface and ground water contamination, air and soil pollution, and other impacts such as noise and odours for surrounding populations (Goa, 2017; Scarlat, 2015).

One of the more significant impacts of landfilling waste (particularly organic waste) is its contribution to methane gas. The waste sector contributes approximately 20% of total methane emissions globally, making it the third-largest source of methane emissions (GAIA, 2022). According to GAIA (2022), methane is short-lived and extremely potent, and over a 20-year lifespan, has over 82.5 times the warming potential of carbon dioxide (CO_2).

Municipal solid waste contributes to the majority of waste sector emissions (GAIA, 2022). Within South Africa, it was estimated that the waste sector generated 23 Mt of GHG (both methane and carbon dioxide emissions), measured in Carbon Dioxide Equivalent (CO_2e) in 2020, with solid waste disposal contributing 79.2% of this (DFFE, 2022).

1.2.2 Managing Organic Waste

Due to the negative impacts caused by the current MSW system, particularly the methane created through landfilling of organic waste, global focus has shifted towards more sustainable, alternative approaches to managing MSW.

Municipalities in South Africa have a responsibility for MSW management, and there are numerous benefits for them in diverting organic waste into alternative treatment methods such as composting and anaerobic digestion (i.e., the production of biogas).

Firstly, this assists municipalities in attempting to meet national waste reduction and organic waste diversion targets. Secondly, this provides potential economic benefits such as reduced expenditure on transporting and landfilling of waste and the creation of additional revenue streams from power, biofuels, compost, and other products (Usmani, 2021).

The following image presents the hierarchy for managing food and other organic waste.

As with all other types of waste, prevention is the most preferred option. Where food waste cannot be prevented and is still edible, it should be recovered for human consumption. Where not edible, this can be channelled into local livestock farming operations as animal feed. Should neither of these options be suitable, the next most preferred option could be residential backyard composting, or if not generated by residents, then channelled into small-scale decentralised composting operations. Thereafter, the next most preferred option would be centralised composting or anaerobic digestion, followed by mechanical biological treatment. Finally, and only if no other options are available, food and other organic waste should either be incinerated or sent to landfill.

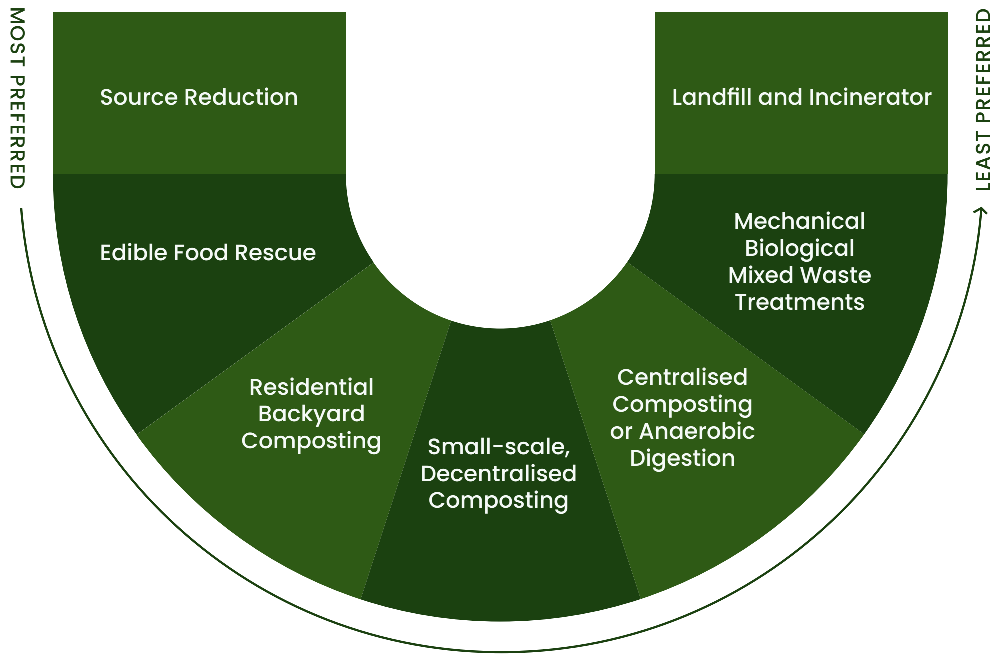


Figure 7: Hierarchy for reducing and recycling food scraps and other food scraps and other organic discards

Given the urgent warnings from scientific panels on the need to rapidly reduce harmful GHG emissions to slow global warming, these last two technical processes for managing organic waste (i.e., landfilling and incineration) are no longer viable or responsible solutions.

The C40 Leadership Group indicates that for cities in the global south that do not have good waste separation, MSW comprises high levels of food waste, which renders incineration one of the least efficient ways to produce energy compared to renewable sources (C40, 2019).

It is also more expensive, as additional fuel needs to be added, and creates air pollution, and as such, they indicate that incineration is one of the worst approaches taken by cities towards reducing waste and meeting energy goals (C40, 2019).

1.2.1 Policy Framework

Within South Africa, there are several strategic plans and relevant legislative requirements that support the diversion of organic waste from landfill into alternative technologies.
Of importance are:

- National Environmental Management: Waste Act (2008),
- National Norms and Standards for Disposal of Waste to Landfill (2013),
- National Organic Composting Strategy (2013),
- National Waste Management Strategy (2020),
- National Norms and Standards for Organic Waste Composting (2021), and
- National Norms and Standards for Treatment of Organic Waste (2022).

The latter two are particularly important as they establish regulations that both reduce the restrictions for a range of organic waste treatment options and reduce regulatory barriers for compost producers that process more than 10 tonnes of organic waste per day (GreenCape, 2022).

The Norms and Standards for Disposal of Waste to Landfill (2013) were developed to place restrictions on a range of waste streams going to landfill. The Norms and Standards specified that in five years' time (by 2018), 25% of garden waste was to be diverted from a baseline at a particular landfill, and that in 10 years' time (by 2023), that would increase to 50% of garden waste (DEA, 2013). In addition, within Pillar One of the National Waste Management Strategy 2020, minimisation of waste to landfill, specifically organic waste, as well as prevention of food waste, are focus areas (DFFE, 2020).

A key intervention in addressing this is to divert organic waste from landfill through composting and recovery of energy (DFFE, 2020).

The eThekwini Municipality was the first African city to complete a Paris-aligned Climate Action Plan (CAP) in collaboration with the C40 Leadership Group.

In their plan, the municipality sets out ambitious emissions reduction targets of 40% by 2030 and 80% by 2050.

The figure on the next page depicts the current emissions by sector as well as the business-as-usual and ambitious reduction targets.

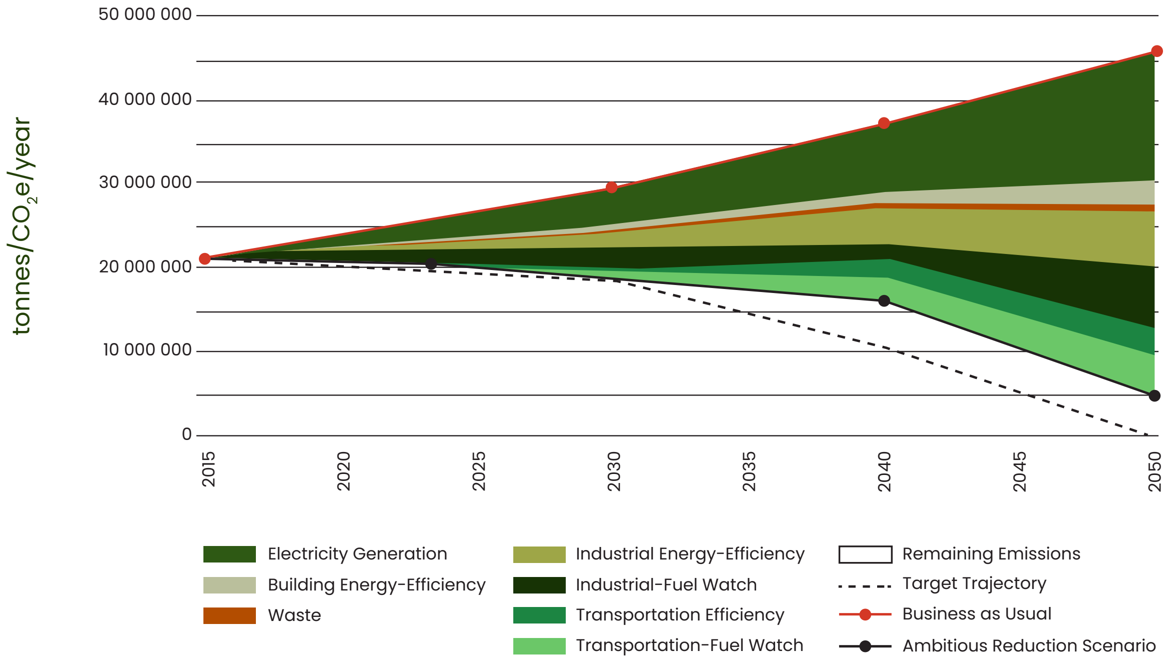


Figure 8: eThekwini Municipality's GHG emissions reduction trajectory

Source: eThekwini Municipality' Climate Action Plan (2019)

In relation to waste management, the municipality intends on reducing waste sent to landfill by 90% by 2050 through reuse, recycling, recovery and re-engineering.

Additionally, by 2030, eThekwini plans to achieve a 50% increase in locally produced food and reduce the volume of good-quality leftover food waste by 80% (eThekwini Municipality, 2019).

To increase local food production, there will be a focus on promoting small-scale community farming cooperatives and community gardens in residential parks. To reduce food waste, the municipality intends to promote circular economic activities by supporting local entrepreneurs in developing composting systems to make use of food waste from residents and businesses (eThekwini Municipality, 2019).

While efforts to support local entrepreneurship for small-scale composting are laudable, it is important to recognise that small-scale composting is not on its own a financially viable business proposition. Currently, and in the foreseeable future, as societies start to restructure waste management in response to climate and social protection goals, local and national governments will continue to hold responsibility for managing organic waste.

Given that many municipalities are already carrying the high costs of sending organic waste to landfill, this report shows how shifting to a municipal-run small-scale, decentralised composting model brings substantive and much needed savings to the municipal coffers. As is outlined in Figure 8, rather than looking to an unlikely profit generation solution, local government can move towards a municipal savings model to meet their CAP goals.

1.3 Goal and Scope

With the above context and rationale in mind, the goal of this CBA is 'to evaluate the costs and benefits of diverting food and garden waste from landfill into small-scale decentralised compost production to determine if there is a net benefit or cost to the eThekwini Municipality'. The results of the CBA will be used by policymakers both within and outside the eThekwini Municipality to better understand the potential for diverting MSW into composting operations.

The specific scope of work that was carried out to achieve this goal is outlined below:

- Review all research reports and databases and capture relevant information and data.
- Create a list of output indicators to identify specific information requirements.
- Identify gaps in current data and engage with stakeholders to plug data gaps.
- Develop a cost-benefit analysis model over a 10-year period and determine net cost/benefits, Net Present Value (NPV), and Benefit-Cost Ratio (BCR).
- Develop a sensitivity analysis for the most significant variables.
- Present the results of the CBA model to a range of stakeholders to gain input.
- Plug any final information gaps and finalise the CBA model.
- Develop a report that captures the process and results.

1.4 Definitions

The following key definitions are applied to this research:

- Food waste in the context of this research relates only to waste of fruit and vegetables, which is generated as part of the retail process from traders at the Early Morning and Bangladesh Markets.
- Composting refers to 'open windrow composting', which is an aerobic method of composting organic waste in rows, which are regularly turned to oxygenate the organic waste and speed up the decomposition process.

Approach and Methodology

SECTION 2

2.1 CBA Methodology

Cost-benefit analysis is a common economic assessment tool. A CBA includes all the benefits and costs of a project to determine the net value of performing the project, which is calculated by subtracting the sum of the costs from the sum of the benefits (Christensen, 2010).

CBA is an important tool in evaluating public investment decision making (Kocher, 2018) and is a well suited methodology for the DZW project as it considers both the economic and environmental costs and benefits, unlike other economic assessment tools such as the Cost-Effectiveness Assessment and Life-Cycle Cost assessment.

CBA compares the costs and benefits to the whole of society, and only when the benefits outweigh the costs, should the proposed activities be undertaken. This is done by determining the net value over a defined time-period to arrive at the Net Present Value (NPV).

The formula used is: $$(\text{NPV}\,(i, N)) = \sum_{t=0}^{N} \frac{R_t}{(1+i)^t}$$

Where N is the total number of periods, i is the discount rate, t is time and R_t is the net cash flow at this time. Once calculated, a positive NPV indicates that the project should proceed while a negative NPV indicates that the project should not proceed.

2.2 Approach to the CBA

A CBA model was developed within Microsoft Excel to collate and analyse all the data collected. The approach utilised to develop the model was as follows:

1. Unpack the current status quo and identify alternatives.
2. Develop a list of all monetary and non-monetary costs and benefits and other tangible and intangible outcomes (output indicators).
3. Quantify the costs and benefits (input indicators) using market prices from both primary and secondary research. This comprised of the following:
    a. Gather all existing data collected from the DZW baseline study on volumes of food waste generated from the EMM, as well as data from the baseline study on volumes of food waste generated at the Bangladesh Market.
    b. Gather all existing data on both of the composting projects around inputs (food waste, green and brown garden waste) and the outputs (compost produced). Since the second project had only produced one batch of compost at the time of developing this report, all data relating to the construction of windrows (i.e., the different organic waste feedstocks used) and the compost product was used leveraging the latest data from the first project.
    c. Engage with BSMTAU, CSW and PRC to gather data and refine assumptions where data were missing and/or needed to be confirmed.
    d. Undertake desktop research to gather data on operational and capital expenditure requirements.
    e. Calculate the value, volume, etc., of all input indicators including:
        i. the volume of other feedstock inputs required (i.e. garden waste per tonne of food waste, etc.).
        ii. the expenses required to operate a composting facility of this size (i.e. operational costs).
        iii. the capital requirements (i.e. equipment and machinery requirements).
    f. Project all benefits and costs over a 10-year period.
4. Select a discount rate and calculate the NPV and cost-benefit ratio.
5. Undertake a sensitivity analysis to test the impact of changes on key variables on the NPV.

2.3 Limitations to the CBA

The accuracy of data provided by municipal departments is a limitation to the study. Data has been provided on the amount of garden waste removed from both the Botanic Gardens and District 8 by the PRC Unit. In addition, data on the cost of the waste removal service from the EMM and Bangladesh Market was provided by BSU. However, the accuracy of this data could not be validated.

Another limitation relates to operational expenditure data. Most operational expenditure items are determined by considering the current project's requirements and then estimating the requirements to scale-up to full production using relevant market prices.

However, given the length of time over which the projects have been implemented (approximately two and a half years to date), the DZW team has been able to collect a range of detailed data, which allows for greater accuracy and confidence.

Costs and Benefits

SECTION 3

3.1 Status Quo and Alternative

At the start of the projects, all food waste from the EMM and Bangladesh Market, as well as the garden waste from the Botanic Gardens and District 8, was being removed by CSW and transported to landfill.

In the case of waste from the EMM and the Botanic Gardens specifically, this is transported on a 19.6km round trip to the Electron Road Transfer Station, while waste generated at the Bangladesh Market and District 8 travels approximately 21km to the Transfer Station. From there, all the waste then travels a further 66km round trip to the Buffelsdraai Landfill.

Associated with this is the cost of waste removal for the BSMTAU and PRC Unit, the landfill and airspace costs[2] for CSW (which includes transport costs), the cost of GHG emissions from waste at landfill, and the social externality costs associated with these landfill activities. There are no benefits to the status quo.

The alternative is to divert food waste from the EMM to the Botanic Gardens, where it will be combined with green and brown garden waste from the Botanic Gardens' maintenance activities, to produce compost. In the case of the Bangladesh Market, food waste is transferred to a composting site at Depot 6, where it is combined with garden waste from PRC District 8, to produce compost.

This reduces the need to transport both the food and garden waste to landfill, along with all the associated transport, landfill, and airspace costs, and reduces GHG emission costs and social externality costs substantially.

[2] Landfill and airspace costs account for all the capital and operational costs associated with operating and maintaining landfills for the Cleansing and Solid Waste Unit.

3.2 Identification of Costs and Benefits

Based on the status quo and alternative presented above, all the costs and benefits of each option are presented in the following table.

Table 1: Costs and benefits of each of the options

Status Quo (Landfill)		Alternative (Diversion)	
Costs	**Benefits**	**Costs**	**Benefits**
Cost of waste removal service from EMM and Bangladesh Market for BSMTAU Cost of waste removal service from Botanic Gardens and District 8 for PRC Unit Landfill cost for CSW for waste removed from fresh produce markets and parks Landfill airspace cost for CSW for waste removed from fresh produce markets and parks Cost of GHG emissions from waste at landfill Social externality cost of landfill activities	No benefits of the status quo	Cost of transporting food waste from EMM and Bangladesh Market to Depot 6 Cost of producing compost at Botanic Gardens and Depot 6	Saving of cost of waste removal from EMM & Bangladesh Market for BSMTAU Saving of cost of waste removal from Botanic Gardens and District 8 for PRC Saving of landfill cost for CSW Saving of landfill airspace cost for CSW Saving in GHG emission costs of waste diverted from landfill Savings on social externality costs of landfill activities avoided Saving on cost of purchasing compost for PRC Unit

Within the status quo, there are no benefits accrued to the municipality; the current waste management activities utilise resources and accrue costs to the municipality. The costs for the status quo are removal of waste from the EMM, the Bangladesh Market, the Botanic Gardens and District 8, the landfill and airspace costs for CSW of disposing of this waste at landfill, the cost of GHG emissions released at landfill, and the social externality costs of landfill activities.

The revenue for CSW from the above waste removal activities could be viewed as a benefit, however, these resources are likely to be reallocated to other areas since the broader waste management network is under-resourced. The costs of the alternative are the cost of transporting food waste from EMM to the Botanic Gardens and from Bangladesh Market to Depot 6, and the costs (both capital and operational) of the compost production process.

The benefits are significant and include savings to both the markets (Early Morning and Bangladesh) and the parks (Botanic Gardens and District 8) for the reduced CSW waste removal services, landfill and airspace savings to CSW due to less waste being sent to landfill, savings from GHG emissions avoided and negative social externalities avoided (from sending waste at landfill), and savings for the PRC Unit from not having to purchase compost.

3.3 Assumptions

In development of the model, several assumptions were made. These are listed below:

- The CBA model considers financial flows within the eThekwini Municipality as a whole (i.e., the net savings and costs to the municipality and not per department/unit).
- The CBA model has been developed for a full 'scaling-up' of the composting projects - a key assumption is that all food waste from the EMM and Bangladesh Market will be diverted into the composting operations.
- The 2022 food waste baseline volume for EMM (330 tonnes) and the 2024 food waste baseline from the Bangladesh Market (85.5 tonnes) are used from 2025 to 2034 (i.e., there is no growth in food waste).
- Only direct costs of producing compost are included - costs such as communications, marketing, etc. are already accounted for in existing PRC budgets.
- Capital investment costs are included for a truck, bobcat, and woodchipper.
- Human resources required to maintain the operation are one full-time supervisor and six full-time labourers, as well as four part-time labourers to support turning of windrows one day per week.
- Sufficient land is available to undertake composting of all the food waste at the Botanic Gardens and Depot 6.
- No rental is paid as this land is the property of the eThekwini Municipality. The same would apply to composting facilities on other municipally-owned sites.
- The composting production requires an improved separation process at the EMM and Bangladesh Market to ensure that paper and plastics (which comprises approximately 10% of total waste generated at both markets) are removed.
- Given that the current waste management system in eThekwini is constrained, the loss of revenue for CSW for the waste management service to the markets and parks is offset by the value gained through additional capacity created by not having to provide that waste removal service any longer, and these services can be deferred to other areas that lack services.
- The CBA uses constant 2025 prices, with no monetary inflation applied between 2025 and 2034. All prices are excluding VAT.

3.4 Machinery and Equipment Costs

The machinery and equipment cost requirements are presented in the table below, along with the variables that are used to determine the repayment schedule. The total cost requirement is approximately R1,68 million to be repaid over five years.

Table 2: Capital cost requirements and variables

Machinery and Equipment	Capital Cost
Truck	R346,956.52
Bobcat	R708,500.00
Wood Chipper	R625,000.00
TOTAL	**R1,680,456.52**

Number of Years	5
Interest Rate	11%
Principal	R1,680,456.52
Payment	R36,573.20

The depreciation and interest repayable are summarised in the table below. The detailed breakdown of the repayment schedule is provided in Annexure 1.

Table 3: Depreciation and interest repayable over the five-year period

Year	2025	2026	2027	2028	2029
Depreciation[3]	R336,091.30	R336,091.30	R336,091.30	R336,091.30	R336,091.30
Interest	R171,665.90	R140,794.38	R106,350.44	R67,920.68	R25,043.88

3.5 Land Preparation and Establishment Costs

No infrastructure development is required since the volume of organic waste being processed per day (approximately three tonnes per day across both sites) does not warrant such infrastructure. However, some basic land preparation would be necessary to ensure that the land is correctly graded and that a basic leachate system is in place. It is assumed that R500,000 would be required across both sites. In addition, a 12m storage container is included for each site to secure tools and equipment at the cost of R25,000 per container. As such, land preparation and establishment costs of R550,000 are included in the first year of operation.

[3] Also referred to as the 'recoupment of capital'.

3.6 Input Indicators

The detailed input indicators used as part of the CBA model are provided within Annexure 2. The tables provide the indicators, unit and value per indicator, and the source of data. The specific notes relating to how each indicator is calculated are provided within the CBA model sheet.

Findings of the CBA

SECTION 4

4.1 Benefits and Costs

All the benefits and costs were projected over a 10-year period. Annexure 3 provides the detailed breakdown of each of the benefits and costs, which are totalled and provided across the 10-year period within the graph below.

Within the status quo, there are no benefits. The costs, which are constant from 2025 to 2034 since the model is a real-growth model, are R3.19 million per year from 2025 to 2034, totalling R31.9 million over the 10-year period. The benefits for the alternative are R3.16 million per year, totalling R31.64 million over the 10-year period. The costs of the alternative are R2.11 million in 2025, and gradually decline over the first five years to R1.41 million in 2029 as the machinery and equipment is paid off. Thereafter, from 2030 to 2034, the costs remain R1.05 million per annum. In total, costs for the alternative are R13.27 million for the 10-year period.

The total costs and benefits for each scenario are presented in Figure 9 below. The benefits of the alternative are almost equal to the costs of the status quo[4]. This is due to the fact that all of the costs (i.e., landfill and airspace costs, cost of purchasing compost, waste management costs, etc.) in the status quo become savings in the alternative, when waste is diverted from landfill into compost production.

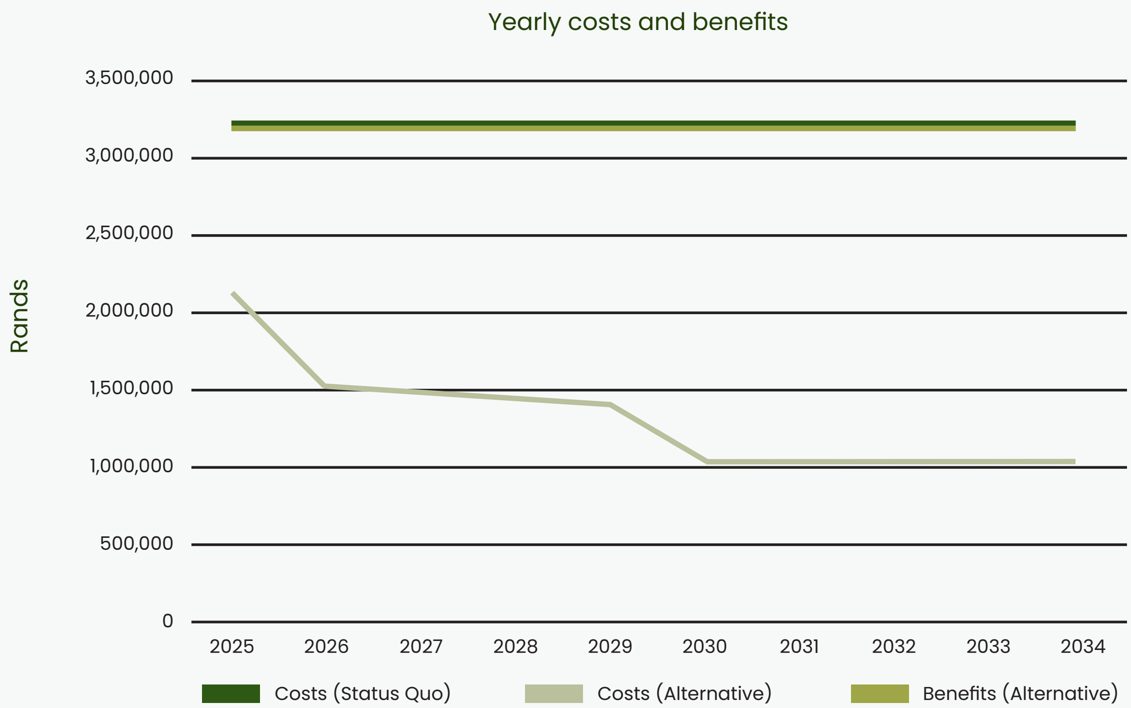


Figure 9: Benefits and costs (2025 to 2034)

[4] The slight difference between the cost of the status quo and benefits of the alternative is due to the GHG emissions that are generated during the composting process, which lower the cost of emissions avoided.

4.2 Net Cost and Benefit

The net cost and benefit is calculated for the period 2025 to 2034 for the status quo and alternative by subtracting the costs from the benefits. The figure below depicts the net cost and benefit for each.

For the status quo, there is a net cost to the eThekwini Municipality of R3.19 million per year, while in the alternative, there is a net benefit of R1.05 million in 2025, increasing to approximately R1.7 million between 2026 to 2029, and further increasing to R2.11 million from 2030 onwards.

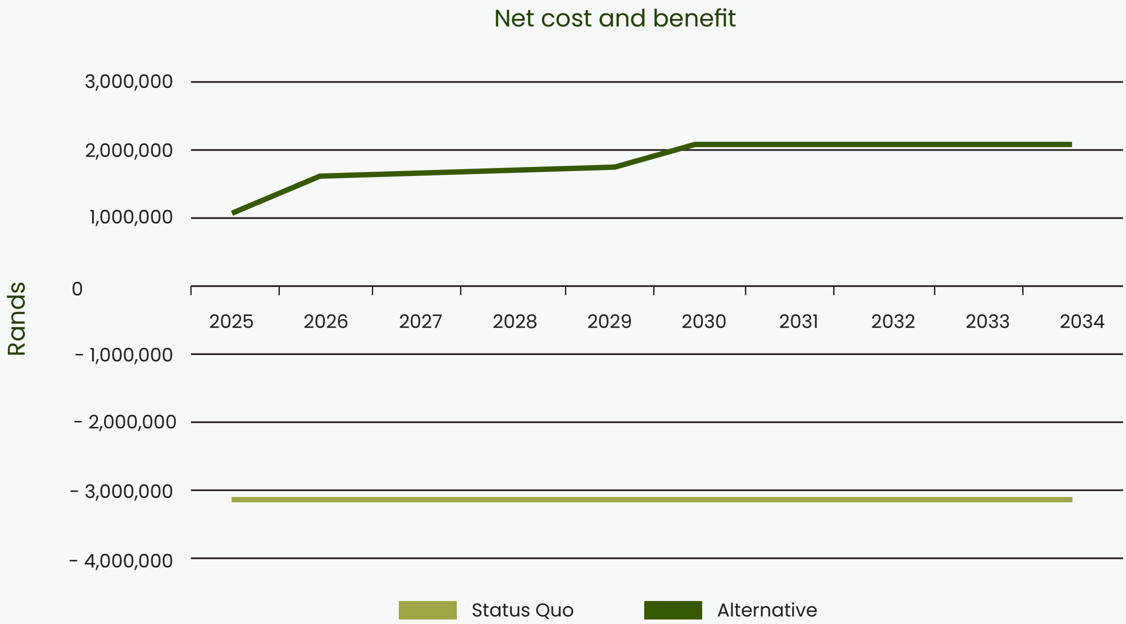


Figure 10: Net cost/benefit (2025 to 2034)

4.3 Net Present Value and Cost-Benefit Ratio

Finally, the net present value and cost-benefit ratios are calculated. Where the NPV is greater than R1, this indicates that the project is viable and will generate a greater net value than investing in an alternative project at the current market interest rate. The same applies to a BCR of more than one.

Table 4: Results of the CBA model

Cost Benefit Analysis	Status Quo	Alternative
Present value of future benefits (Discount rate: 5.7%)	R0	R24,951,141
Present value of future costs (Discount rate: 5.7%)	R25,205,419	R10,839,629
Cost Benefit Analysis		
Net Present Value (NPV) Sum of present value of future benefits - sum of present value of future costs	-R25,205,419	R14,111,511
Benefit Cost Ratio (BCR) Sum of present value of future benefits / sum of present value of future costs	0.00	2.3

- As presented above, there is an NPV of -R25.2 million in the status quo.
- Within the alternative, there is an NPV of R14.1 million which translates into a BCR of 2.3.
- This indicates that there is an overall net cost to society of continuity to send organic waste to landfill, while when this is diverted from landfill into compost production, this results in a net benefit to society.
- This suggests that scaling up the current composting production projects would generate an overall benefit to the municipality even when purchasing new, dedicated capital equipment.

4.4 Sensitivity Analysis

A sensitivity analysis was conducted to test the impact of some key CBA model variables on the NPV of the status quo and alternative. This is done to ensure that should there be any significant changes to the selected variables, the anticipated impact on the NPV of the project can be understood.

The variables selected are those which currently have the largest contribution to either the costs or benefits within the model, and which are the most likely to substantially impact on the NPV of the project.

Table 5: Results of the sensitivity analysis

Discount Rate	Status Quo	Alternative
5.0%	(R25,920,846)	R14,560,245
5.7%	**(R25,205,419)**	**R14,111,511**
8.0%	(R23,168,426)	R12,836,936
10.0%	(R21,608,716)	R11,864,475

Interest Rate	Status Quo	Alternative
11.00%	**(R25,205,419)**	**R14,111,511**
13.00%	(R23,479,991)	R12,938,996
15.00%	(R21,954,575)	R11,896,487

Landfill and Airspace Cost Per Tonne	Status Quo	Alternative
R1,774	**(R25,205,419)**	**R14,111,511**
R1,200	(R21,865,660)	R10,771,752
R800	(R19,538,301)	R8,444,394
R500	(R17,792,783)	R6,698,875

It is clear from the above analysis that the project is only marginally impacted by large changes in the key variables selected. Even at a high real discount rate of 10%, when the interest rate increases to 15%, or when there is a decline in the landfill and airspace cost to R500 per tonne, the NPV is still negative in the status quo and positive in the alternative.

In addition to the tables above, two other sensitivity analyses were conducted. In the first, all external (indirect, non-monetary) costs and benefits were excluded from the model.

This included landfill and airspace costs, social externality costs, and GHG emission costs in the status quo, and the benefits of these variables in the alternative. When these are excluded, the NPV of the status quo is -R14.2 million while the NPV of the alternative is R1.9 million. As such, even when these indicators are excluded, diverting organic waste from landfill still has a positive net benefit to society. This is because there is a substantial cost associated with sending all the organic waste from the markets and parks to landfill.

In the second analysis, all the costs and benefits related to the waste removal service was excluded from the model. Effectively, this assumes that there is no cost of removing organic waste from the markets and parks in the status quo, and no benefits from avoided waste removal costs in the alternative.

Even in this case, the NPV of the status quo is -R14.7 million while the NPV of the alternative is R3.6 million. This is due to the fact that there are substantial external costs associated with landfilling organic waste, and these outweigh the lost benefits from saving on waste removal.

Conclusion

SECTION 5

5.1 Summary of Key Findings

The study utilises a CBA model to determine the net value of two composting projects, considering the quantifiable costs and benefits. Due to the substantial costs associated with sending waste to landfill in eThekwini (limited landfill space, long distances, etc.) and the savings generated from diverting waste and creating compost, the study has indicated that the projects create a net positive benefit to the eThekwini Municipality. Additionally, there are numerous other positive impacts that are created through this project. These impacts, along with specific outcomes, are presented in the table below.

Table 6: Impacts and outcome from the DZW project

Impact	Outcome
Financial impact for the municipality	• Savings on waste disposal to PRC and BSTMAU • Savings on compost purchase for PRC • Savings on landfill and airspace costs for CSW
Employment impacts	• Creation of new, green employment opportunities for the city (an estimated seven full-time and four part-time jobs for 737 tonnes of organic waste diverted)
Socio-economic impacts	• Locates viable and green economic activities within communities which can address spatial and other inequalities
Climate and environmental impact	• Reduction in GHG emissions from organic waste diversion and reduced transport (622 tonnes of CO_2e per year) • Avoided methane emissions from organic waste diverted (168 tonnes per year, included in the above GHG emissions) • Production of compost to replenish soil and support local food production (296 tonnes per year)
Impact on traders	• Reinvestment of savings for BSMTAU into market infrastructure to improve working conditions for market traders and vendors • Increased education about the impact of food waste and climate change
Institutional impacts	• Successful transversal partnership model within the municipality • Creation of a strong, circular economy model for replication to create a patchwork of small, closed loops across the city
Educational impacts	• Creation of training opportunities for students • Creation of broad awareness and education around food waste, zero waste models and climate change mitigation

Other than the financial impacts in terms of savings for various municipal departments, there are impacts such as the creation of new green jobs, better working conditions for informal traders, positive environmental and climate impacts, education and awareness creation, and stronger institutional partnerships.

The results of the research indicate that the project has the potential to create positive economic value within the city, as well as contributing towards climate change mitigation, employment creation, improved working conditions for informal traders, better awareness and education, and transversal governance ambitions.

5.2 Recommendations

5.2.1 Current DZW Composting Projects

Scaling up of the current DZW composting projects should continue to be supported by the eThekwini Municipality. Operational relationships currently exist between the relevant departments and DZW team, and these should continue with the aim of optimising current processes.

Since broad buy-in has been achieved for the project, going forward, departmental and DZW representatives need to ensure that the model that has been successfully demonstrated can be embedded into municipal structures, plans and budgets. This will allow these projects to be institutionalised within the city, to transition these projects towards full municipal operation.

To scale the projects from the current level to full diversion of food waste from both of the markets, some initial capital will be required. As such, a project plan will need to be developed to outline the approach to be taken, the key stakeholders and their roles and responsibilities, institutional requirements, an operational structure, budget, and timeframes.

5.2.2 Other Potential Projects

Based on the results of the analysis and given that a new project has been successfully implemented as an example of scale-up potential, it is highly likely that other projects of a similar nature would be equally as viable within eThekwini.

Expansion of this concept to other fresh produce markets in the city will have an even greater impact and allow the PRC and BSMTAU to be leading contributors towards addressing the municipal Climate Action Plan targets.

Additionally, the benefits of reduced landfill space will allow CSW to reallocate their over-capacitated city fleet towards greater priority areas and ensure cost savings across the board.

To action this, an assessment needs to be undertaken to identify all fresh produce markets within the eThekwini Municipality and nearby parks and public open spaces within a 10km radius.

Thereafter, the relevant operational managers can engage to identify the potential for such a project to be implemented and arrangements can be made to initiate a project. This would require buy-in from the municipal leadership at the highest level to support replication across all nine markets in the city.

The current MOU does provide a strong basis for municipal buy-in and support to be enhanced. The DZW team can, with support from BSMTAU, PRC and CSW, assist in determining the city-wide impact if this project is implemented throughout the municipality, which would assist to further motivate for support and funding.

Based on an understanding of the volumes of food waste at the municipal level, other opportunities could be explored such as small-scale anaerobic digestion, which could provide biogas to food vendors at fresh produce markets.

Annexures

SECTION 6

6.1 Annexure 1: Detailed Machinery and Equipment Repayment Schedule

Period	Month	Balance	Interest	Principal Paid	New Balance
0					R1,680,456.52
1	January 2025	R1,680,456.52	R15,404.18	R21,133.01	R1,659,323.51
2	February 2025	R1,659,323.51	R15,210.47	R21,326.73	R1,637,996.78
3	March 2025	R1,637,996.78	R15,014.97	R21,522.23	R1,616,474.55
4	April 2025	R1,616,474.55	R14,817.68	R21,719.51	R1,594,755.04
5	May 2025	R1,594,755.04	R14,618.59	R21,918.61	R1,572,836.43
6	June 2025	R1,572,836.43	R14,417.67	R22,119.53	R1,550,716.90
7	July 2025	R1,550,716.90	R14,214.90	R22,322.29	R1,528,394.61
8	August 2025	R1,528,394.61	R14,010.28	R22,526.91	R1,505,867.70
9	September 2025	R1,505,867.70	R13,803.79	R22,733.41	R1,483,134.29
10	October 2025	R1,483,134.29	R13,595.40	R22,941.80	R1,460,192.49
11	November 2025	R1,460,192.49	R13,385.10	R23,152.10	R1,437,040.39
12	December 2025	R1,437,040.39	R13,172.87	R23,364.33	R1,413,676.06
13	January 2026	R1,413,676.06	R12,958.70	R23,578.50	R1,390,097.56
14	February 2026	R1,390,097.56	R12,742.56	R23,794.64	R1,366,302.93
15	March 2026	R1,366,302.93	R12,524.44	R24,012.75	R1,342,290.17
16	April 2026	R1,342,290.17	R12,304.33	R24,232.87	R1,318,057.30
17	May 2026	R1,318,057.30	R12,082.19	R24,455.00	R1,293,602.30
18	June 2026	R1,293,602.30	R11,858.02	R24,679.18	R1,268,923.12
19	July 2026	R1,268,923.12	R11,631.80	R24,905.40	R1,244,017.72
20	August 2026	R1,244,017.72	R11,403.50	R25,133.70	R1,218,884.02
21	September 2026	R1,218,884.02	R11,173.10	R25,364.09	R1,193,519.93
22	October 2026	R1,193,519.93	R10,940.60	R25,596.60	R1,167,923.33
23	November 2026	R1,167,923.33	R10,705.96	R25,831.23	R1,142,092.10
24	December 2026	R1,142,092.10	R10,469.18	R26,068.02	R1,116,024.08
25	January 2027	R1,116,024.08	R10,230.22	R26,306.98	R1,089,717.10
26	February 2027	R1,089,717.10	R9,989.07	R26,548.12	R1,063,168.98
27	March 2027	R1,063,168.98	R9,745.72	R26,791.48	R1,036,377.50
28	April 2027	R1,036,377.50	R9,500.13	R27,037.07	R1,009,340.43

Period	Month	Balance	Interest	Principal Paid	New Balance
29	May 2027	R1,009,340.43	R9,252.29	R27,284.91	R982,055.52
30	June 2027	R982,055.52	R9,002.18	R27,535.02	R954,520.50
31	July 2027	R954,520.50	R8,749.77	R27,787.43	R926,733.07
32	August 2027	R926,733.07	R8,495.05	R28,042.14	R898,690.93
33	September 2027	R898,690.93	R8,238.00	R28,299.20	R870,391.73
34	October 2027	R870,391.73	R7,978.59	R28,558.61	R841,833.13
35	November 2027	R841,833.13	R7,716.80	R28,820.39	R813,012.74
36	December 2027	R813,012.74	R7,452.62	R29,084.58	R783,928.16
37	January 2028	R783,928.16	R7,186.01	R29,351.19	R754,576.97
38	February 2028	R754,576.97	R6,916.96	R29,620.24	R724,956.73
39	March 2028	R724,956.73	R6,645.44	R29,891.76	R695,064.97
40	April 2028	R695,064.97	R6,371.43	R30,165.77	R664,899.20
41	May 2028	R664,899.20	R6,094.91	R30,442.29	R634,456.91
42	June 2028	R634,456.91	R5,815.86	R30,721.34	R603,735.57
43	July 2028	R603,735.57	R5,534.24	R31,002.95	R572,732.62
44	August 2028	R572,732.62	R5,250.05	R31,287.15	R541,445.47
45	September 2028	R541,445.47	R4,963.25	R31,573.95	R509,871.52
46	October 2028	R509,871.52	R4,673.82	R31,863.37	R478,008.15
47	November 2028	R478,008.15	R4,381.74	R32,155.46	R445,852.69
48	December 2028	R445,852.69	R4,086.98	R32,450.21	R413,402.48
49	January 2029	R413,402.48	R3,789.52	R32,747.67	R380,654.80
50	February 2029	R380,654.80	R3,489.34	R33,047.86	R347,606.94
51	March 2029	R347,606.94	R3,186.40	R33,350.80	R314,256.14
52	April 2029	R314,256.14	R2,880.68	R33,656.52	R280,599.63
53	May 2029	R280,599.63	R2,572.16	R33,965.03	R246,634.59
54	June 2029	R246,634.59	R2,260.82	R34,276.38	R212,358.22
55	July 2029	R212,358.22	R1,946.62	R34,590.58	R177,767.64
56	August 2029	R177,767.64	R1,629.54	R34,907.66	R142,859.98
57	September 2029	R142,859.98	R1,309.55	R35,227.65	R107,632.33
58	October 2029	R107,632.33	R986.63	R35,550.57	R72,081.76
59	November 2029	R72,081.76	R660.75	R35,876.45	R36,205.31
60	December 2029	R36,205.31	R331.88	R36,205.31	R0.00
			R511,775.28	**R1,680,456.52**	

6.2 Annexure 2: Detailed Input Indicators

6.2.1 General CBA Indicators

General CBA Indicators	Unit	Value	Source
Other Assumptions			
Prime lending rate	Percentage	11%	SARB
Inflation rate (CPI)	Percentage	5%	StatsSA
Discount rate (Real rate of return)	Percentage	5.7%	Own
Operational days per month	Days	21.0	Own
Weeks per year	Weeks	52.0	Own
Months per year	Months	12.0	Own
Cost of maintenance of machinery and buildings (annual)	Percentage	10%	Own
Time period for present value of money	Years	10.0	Own
Resource Prices			
Average price of diesel per litre	Rands/litre	18.63	SAPIA
Average price of petrol per litre	Rands/litre	20.80	SAPIA
Water cost per kilolitre 2024/2025	Rands/kilolitre	57.6	eThekwini
Water cost per kilolitre 2025/2026	Rands/kilolitre	66.1	eThekwini
Water cost per kilolitre 2026/2027	Rands/kilolitre	76.0	eThekwini
Average annual increase 2026-2032	Percentage	14.937%	Own
Fixed monthly cost 2024/2025	Rands	459.6	eThekwini

6.2.2 Waste Removal and Diversion Indicators

Waste Removal and Diversion Indicators	Unit	Value	Source
Indicators for Current Waste Removal Charges			
Value of waste removal service from Botanic Gardens per year (garden waste)	**Rands**	**R65,880**	
Tonnes of garden waste currently sent to landfill per month (Botanic Gardens)	Tonnes	30.0	PRC
Tonnes of garden waste currently sent to landfill per year (Botanic Gardens)	Tonnes	360.0	PRC
Cost of garden waste removal service per tonne	Rand/tonne	183.0	PRC
Cost of garden waste removal per skip per month	Rand	0.0	PRC
Value of waste removal service from District 8 per year (garden waste)	**Rands**	**R314,080**	
Tonnes of garden waste currently sent to landfill per week (District 8)	Tonnes	105.0	PRC
Tonnes of garden waste currently sent to landfill per year (District 8)	Tonnes	5,460.0	PRC
Cost of garden waste removal service per tonne	Rand/tonne	57.5	PRC
Value of waste removal service at markets per year (all waste)	**Rand**	**R1,460,400**	
Value of waste removal service at EMM per month (all waste)	Rand	25,400	BSMTAU
Value of waste removal service at EMM per year (all waste)	Rand	304,800	BSMTAU
Value of waste removal service at Bangladesh Market per month (all waste)	Rand	96,300	BSMTAU
Value of waste removal service at Bangladesh Market per year (all waste)	Rand	1,155,600	BSMTAU
Savings on Waste Removal Charges Due to Diversion			
Savings on waste removal service from Botanic Gardens per year	**Rands**	**R19,972**	
Percentage of total garden generated diverted from landfill	Percentage	30.3%	Own

Waste Removal and Diversion Indicators	Unit	Value	Source
Savings on Waste Removal Charges Due to Diversion			
Savings on waste removal service from District 8 per year	**Rands**	**R3,804**	
Percentage of total garden generated diverted from landfill	Percentage	1.2%	Own
Savings on waste removal service from EMM per year	**Rands**	**R256,459**	
Percentage of total waste as organic waste	Percentage	84.1%	Own
Savings on waste removal service from Bangladesh Market per year	**Rands**	**R1,046,974**	
Percentage of total waste as organic waste	Percentage	90.6%	Own

6.2.3 Production Indicators

Production Indicators	Unit	Value	Source
Windrow Construction			
Food waste contribution (baseline)	Tonnes	416	Own
Food waste contribution to windrows	Percentage	47%	DZW
Brown garden waste contribution to windrows	Percentage	15%	DZW
Wood chip garden waste contribution to windrows	Percentage	21%	DZW
Mature compost contribution to windrows	Percentage	17%	DZW
Organic Waste Diversion (EMM and Botanic Gardens)			
Tonnes of food waste diverted from EMM per year	**Tonnes**	**330.7**	
Tonnes of total waste generated at the EMM per year	Tonnes	393	DZW
Percentage organic (food) waste	Percentage	84%	DZW
Tonnes of garden waste diverted from Botanic Gardens per year	**Tonnes**	**255.7**	
Brown garden waste diverted into windrows	Tonnes	109	Own
Wood chips diverted into windrows	Tonnes	147	Own
Tonnes of all organics into compost	**Tonnes**	**708.9**	
Total food, garden and wood chip waste diverted	Tonnes	586	Own
Total mature compost into composting	Tonnes	123	Own

Production Indicators	Unit	Value	Source
Organic Waste Diversion (Bangladesh Market and District 8)			
Tonnes of food waste diverted from Bangladesh Market per year	**Tonnes**	**85.5**	
Tonnes of total waste generated at the Bangladesh Market per year	Tonnes	94.4	DZW
Percentage organic (food) waste	Percentage	91%	DZW
Tonnes of garden waste diverted from District 8 per year	**Tonnes**	**66.1**	
Brown garden waste diverted into windrows	Tonnes	28	Own
Wood chips diverted into windrows	Tonnes	38	Own
Tonnes of all organics diverted	**Tonnes**	**183.4**	
Total food, garden and wood chip waste diverted	Tonnes	152	Own
Total mature compost into composting	Tonnes	32	Own
Compost Production (Botanic Gardens)			
Tonnes of compost produced per annum	**Tonnes**	**235.5**	
Organic feedstock into composting per annum	Tonnes	708.9	As above
Reduction factor (percentage of total organic waste to compost)	Percentage	66.8%	DZW
Compost Production (Depot 6)			
Tonnes of compost produced per annum	**Tonnes**	**60.9**	
Organic feedstock into composting per annum	Tonnes	183.4	As above
Reduction factor (percentage of total organic waste to compost)	Percentage	66.8%	DZW
Compost Production (Total)			
Total feedstock composted at both sites per year	Tonnes	892.2	Own
Total feedstock diverted into composting (total less mature compost)	Tonnes	738.0	Own
Total compost produced at both sites per year	Percentage	296.4	Own

6.2.4 Compost Saving Indicators

Compost Saving Indicators	Unit	Value	Source
Compost Savings			
Value of compost purchase per month (current)	**Rand**	**24,815.1**	Own
Amount of compost produced in tonnes per month	Tonnes	24.7	Own
Density of compost	Kilograms per m3	537.5[5]	El-Sayed (2015)
Volumes of compost produced in cubic metres per month	Cubic/metres	46	Own
Current cost of purchasing compost	Rand/cubic metre	540	PRC

6.2.5 Capital and Operational Cost Indicators

Capital and Operational Cost Indicators	Unit	Value	Source
Operational Costs per Month			
Depreciation / recoupment of capital outlays	Rands	As per capital cost requirements	Own
Interest repayment	Rands		Own
Insurance	Rands	3,240	Own
Maintenance (equipment)	Rands	14,004	Own
Fuel costs	Rands	19,266	Own
Water (variable cost)	Rands	39	eThekwini
Water (fixed cost)	Rands	460	eThekwini
PPE	Rands	1,125	PRC
Tools and equipment	Rands	1,650	PRC
Other consumables	Rands	5%	Own

[5]As per this research, the bulk density value ranged from 420 to 655kg m3. An average is used.

Capital and Operational Cost Indicators	Unit	Value	Source
Human Resource Requirements			
Supervisor (full-time)	Units	1	Own
Labourer (full-time)	Units	6	Own
Labourer (part-time) 1 day per week	Units	4	Own
Supervisor	Rands/month	12,000	PRC
Labourer	Rands/month	5,000	PRC
Capital Costs			
Truck	Rands	346,957	FAW
Bobcat	Rands	708,500	Goscor
Wood chipper	Rands	625,000	Tomcat Chippers
Fuel Consumption			
Truck fuel cost per month	**Rands**	**R1,463**	
Truck fuel consumption	Litres per 100km	8.5	JAC
Truck kilometres per month	Kilometres	924.0	Own
Truck litres used per month	Litres	78.5	Own
Bobcat fuel cost per month	**Rands**	**R14,084**	
Bobcat fuel consumption	Litres per hour	4.5	Bobcat
Bobcat operational hours per month	Hours	168.0	Own
Bobcat litres used per month	Litre	756.0	Own
Chipper fuel cost per month	**Rands**	**R3,719**	
Chipper fuel consumption	Litres per cubic metre	2.0	Tomcat Chippers
Cubic metres of garden waste processed per month	Cubic metres	89.4	Own
Chipper litres used per month	Litres	178.8	Own
Water usage cost per month	**Rands**	**R39**	
Water usage per tonne of compost per week	Litres	10.0	Parks

Capital and Operational Cost Indicators	Unit	Value	Source
Average feedstock required per week	Tonnes	17.2	Own
Total water usage per week	Litres	172	Own
Total water usage per month	Litres	686	Own

6.2.6 External Benefits Indicators

External Benefits Indicators	Unit	Value	Source
Indicators for External Benefits of Diversion			
Value of saving on landfill and airspace costs	Rands	R1,309,206	
Cost per tonne to landfill waste	Rand/tonne	1,300	CSW
Savings in landfill airspace	Rand/tonne	474	CSW
Savings on social externality costs of landfill activities avoided	Rand	R83,848	
External cost of landfilling (2011)	Rand	57.5	(Nahman, 2011)
External cost of landfilling (2025)	Rand	113.6	Own
Saving in GHG emission costs of waste diverted from landfill	Rand	R146,722	
GHG emissions factor from transport and collection of waste	Kilograms CO_2e per tonne	11.3	(Fredrich, 2013)
Direct GHG emissions factor from landfilling	Kilograms CO_2e per tonne	1,016.3	(Fredrich, 2013)
Emissions factor for production and application of compost from wet garden waste for turned windrow	Kilograms CO_2e per tonne	185.2	(Fredrich, 2013)
CO_2e emissions avoided per tonne of waste to landfill	Tonnes CO_2e	758.4	Own
CO_2e emissions generated per tonne of compost produced	Tonnes CO_2e	136.7	Own
Net CO_2e emissions avoided per tonne of waste diverted into composting	Tonnes CO_2e	621.7	Own
Carbon tax rate	Rand/tonne	236.0	National Treasury

6.3 Annexure 3: Total Benefits and Costs

6.3.1 Status Quo

Benefits and Costs Status Quo	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	Total
No Benefits	R0	R0	R0	R0	R0	R0	R0	R0	R0	R0	R0
Total Benefits	**R0**	**R0**	**R0**	**R0**	**R0**	**R0**	**R0**	**R0**	**R0**	**R0**	**R0**
Cost of waste removal for BSMTAU	R1,303,432	R1,303,432	R1,303,432	R1,303,432	R1,303,432	R1,303,432	R1,303,432	R1,303,432	R1,303,432	R1,303,432	R13,034,323
Cost of waste removal service for PRC	R23,776	R23,776	R23,776	R23,776	R23,776	R23,776	R23,776	R23,776	R23,776	R23,776	R237,756
Landfill and airspace cost for CSW	R1,309,206	R1,309,206	R1,309,206	R1,309,206	R1,309,206	R1,309,206	R1,309,206	R1,309,206	R1,309,206	R1,309,206	R13,092,058
Cost of purchasing compost for PRC	R297,782	R297,782	R297,782	R297,782	R297,782	R297,782	R297,782	R297,782	R297,782	R297,782	R2,977,816
Cost of GHG emissions from waste at landfill	R178,974	R178,974	R178,974	R178,974	R178,974	R178,974	R178,974	R178,974	R178,974	R178,974	R1,789,742
Social externality cost of landfill activities	R83,848	R83,848	R83,848	R83,848	R83,848	R83,848	R83,848	R83,848	R83,848	R83,848	R838,477
Total Costs	**R3,197,017**	**R3,197,017**	**R3,197,017**	**R3,197,017**	**R3,197,017**	**R3,197,017**	**R3,197,017**	**R3,197,017**	**R3,197,017**	**R3,197,017**	**R31,970,173**

6.3.2 Alternative

Benefits and Costs Alternative	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	Total
BSMTAU saving on waste removal	R1,303,432	R1,303,432	R1,303,432	R1,303,432	R1,303,432	R1,303,432	R1,303,432	R1,303,432	R1,303,432	R1,303,432	R13,034,323
PRC saving on waste removal	R23,776	R23,776	R23,776	R23,776	R23,776	R23,776	R23,776	R23,776	R23,776	R23,776	R237,756
CSW saving on landfill and airspace costs	R1,309,206	R1,309,206	R1,309,206	R1,309,206	R1,309,206	R1,309,206	R1,309,206	R1,309,206	R1,309,206	R1,309,206	R13,092,058
PRC savings on compost purchase	R297,782	R297,782	R297,782	R297,782	R297,782	R297,782	R297,782	R297,782	R297,782	R297,782	R2,977,816
Savings on cost of GHG emissions avoided	R146,722	R146,722	R146,722	R146,722	R146,722	R146,722	R146,722	R146,722	R146,722	R146,722	R1,467,219
Savings on social externality costs avoided	R83,848	R83,848	R83,848	R83,848	R83,848	R83,848	R83,848	R83,848	R83,848	R83,848	R838,477
Total Benefits	**R3,164,765**	**R3,164,765**	**R3,164,765**	**R3,164,765**	**R3,164,765**	**R3,164,765**	**R3,164,765**	**R3,164,765**	**R3,164,765**	**R3,164,765**	**R31,647,650**
Land preparation and establishment costs	R550,000	R0	R0	R0	R0	R0	R0	R0	R0	R0	R550,000
Repayment of capital investment	R336,091	R336,091	R336,091	R336,091	R336,091	R0	R0	R0	R0	R0	R1,680,457
Interest on machinery	R171,666	R140,794	R106,350	R67,921	R25,044	R0	R0	R0	R0	R0	R511,775
Human resource costs	R552,000	R552,000	R552,000	R552,000	R552,000	R552,000	R552,000	R552,000	R552,000	R552,000	R5,520,000
Insurance	R38,876	R38,876	R38,876	R38,876	R38,876	R38,876	R38,876	R38,876	R38,876	R38,876	R388,760
Maintenance (equipment)	R168,046	R168,046	R168,046	R168,046	R168,046	R168,046	R168,046	R168,046	R168,046	R168,046	R1,680,457
Fuel costs	R231,193	R231,193	R231,193	R231,193	R231,193	R231,193	R231,193	R231,193	R231,193	R231,193	R2,311,927
Water (variable cost)	R474	R474	R474	R474	R474	R474	R474	R474	R474	R474	R4,740
Water (fixed cost)	R5,515	R5,515	R5,515	R5,515	R5,515	R5,515	R5,515	R5,515	R5,515	R5,515	R55,153
PPE	R13,500	R13,500	R13,500	R13,500	R13,500	R13,500	R13,500	R13,500	R13,500	R13,500	R135,000
Tools and equipment	R19,800	R19,800	R19,800	R19,800	R19,800	R19,800	R19,800	R19,800	R19,800	R19,800	R198,000
Other consumables	R23,870	R23,870	R23,870	R23,870	R23,870	R23,870	R23,870	R23,870	R23,870	R23,870	R238,702
Total Costs	**R2,111,031**	**R1,530,160**	**R1,495,716**	**R1,457,286**	**R1,414,409**	**R1,053,274**	**R1,053,274**	**R1,053,274**	**R1,053,274**	**R1,053,274**	**R13,274,970**

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