CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 03 - in effect as of: 28 July 2006

CONTENTS

Annexes

SECTION A. General description of project activity

A.1. Title of the project activity:

Title of the project activity: Organic Waste Composting Project in Ipoh City, Malaysia
Version number: 02
Date: 17/1/2011

A.2. Description of the project activity:

The objective of the project is to establish a waste treatment facility with a mechanical segregation process and compositing plant for organic wastes within the site of the existing landfill site in Ipoh City, Perak State, Malaysia. The project activities involves the sorting and recovering of the recyclable, reusable and recoverable resources from mixed municipal waste generated in Ipoh City, and aerobic treatment of the organic waste utilizing composting technology.

In Ipoh City, about 600 tons of municipal solid waste (MSW) is generated daily, and most of them are disposed of in the landfill site wherein landfill gasses are not extracted. Through the above-mentioned project activities, this project will realize the reduction of the amount of landfilled wastes, consequently the reduction of the greenhouse gas (GHG) emission. The proposed waste treatment facility will have a daily input capacity of 50 tons of MSW to be brought to the landfill. Considering the product quality, the compost produced through the project activities will not be sold to the end-user, but will be transported to the landfill site to be utilized as cover soil.
Based on the calculations, the project will realize 43,367 tons CO_2 equivalent emission reduction over the 10 years period from 2013 to 2022.

The project is being developed by LTC Alam Bersih S/B (LT), a company in charge of collection of MSW and management of the landfill from Ipoh City. The implementation of the project including operation of the waste treatment facility will be carried out by LT, and it is planned that some Japanese companies will buy the CER generated by this CDM project.

Besides climate change mitigation, the project will contribute to the sustainable development of Malaysia, in many aspects: Previous to project implementation, waste was disposed of at a landfill with landfill gas being released to the atmosphere, which posed fire and explosion risks. Moreover, direct dumping of organic wastes caused water, soil and air pollution in the surrounding areas. By introducing aerobic treatment and avoiding direct disposal of fresh waste in a landfill site, the proposed project will promote sanitization of landfill site and reduce these negative environmental impacts of the landfill site. This project also contributes to reducing the land requirements for waste disposal as the result of reducing the load of MSW, particularly the contained organics. In addition, the recovery of recyclables activity enables conservation of the natural resources, and is expected to provide more job opportunity to local people compared to landfill disposal, as well.
This project can demonstrate the benefits of an advanced waste treatment procedure for future waste disposal activities in Malaysia, thus the proposed project contributes to development of the sustainable society in Ipoh City which is in line with the national policy of Malaysia.

A.3. Project participants:

Name of Party involved ((host) indicates a host Party)	Private and/or public entity (ies) project participants (as applicable)	Kindly indicate if the party involved wishes to be considered as project participant (Yes/No)
Malaysia (host)	LTC ALAM BERSIH (LT)	No
Japan	To be determined	No

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

>>

A.4.1.1. Host Party(ies):

Malaysia

A.4.1.2. Region/State/Province etc.:

Perak State

A.4.1.3. City/Town/Community etc.:

Ipoh City

A.4.1.4. Details of physical location, including information allowing the unique identification of this project activity (maximum one page):

The treatment facility for MSW will be constructed at the part of the landfill site located in Kampung Lim Tang in Ipoh City. Ipoh city is the capital of Perak State, in the northern part of West Malaysia. Ipoh City is about 200 km to the north of Kuala Lumpur. The latitudes and longitudes of the project site are given below:
Latitude: 4^{o}39’31.96” N
Longitude: 101 ^{o} 9’8.90” E

Figure 1: Map of Malaysia and Ipoh City

A.4.2. Category(ies) of project activity:

The project falls under the Sectoral Scope 13: “Waste handling and disposal”.

A.4.3. Technology to be employed by the project activity:

The principal technology to be applied in this project activity is mechanical segregation and hand-sorting of MSW and composting of organic wastes, followed by a stabilization process.
The process starts with the separation of MSW into recyclable materials, organic waste, and other waste, by using trommel (mechanical segregation) and belt conveyer (hand-sorting). Organic waste in this project includes organic matters such as food waste, wood, and papers which cannot be recycled. Once separated, the organic fraction enters in the bio-treatment areas, and the biological degradation process starts. During the process, organic waste is decomposed aerobically under controlled temperature, humidity, and air concentration, consequently its volume becomes small. After being stabilized with adequate humidity, it is transported to the landfill site, and disposed of, or utilized as cover soil.

A schematic diagram of the process is shown in Figure 2.

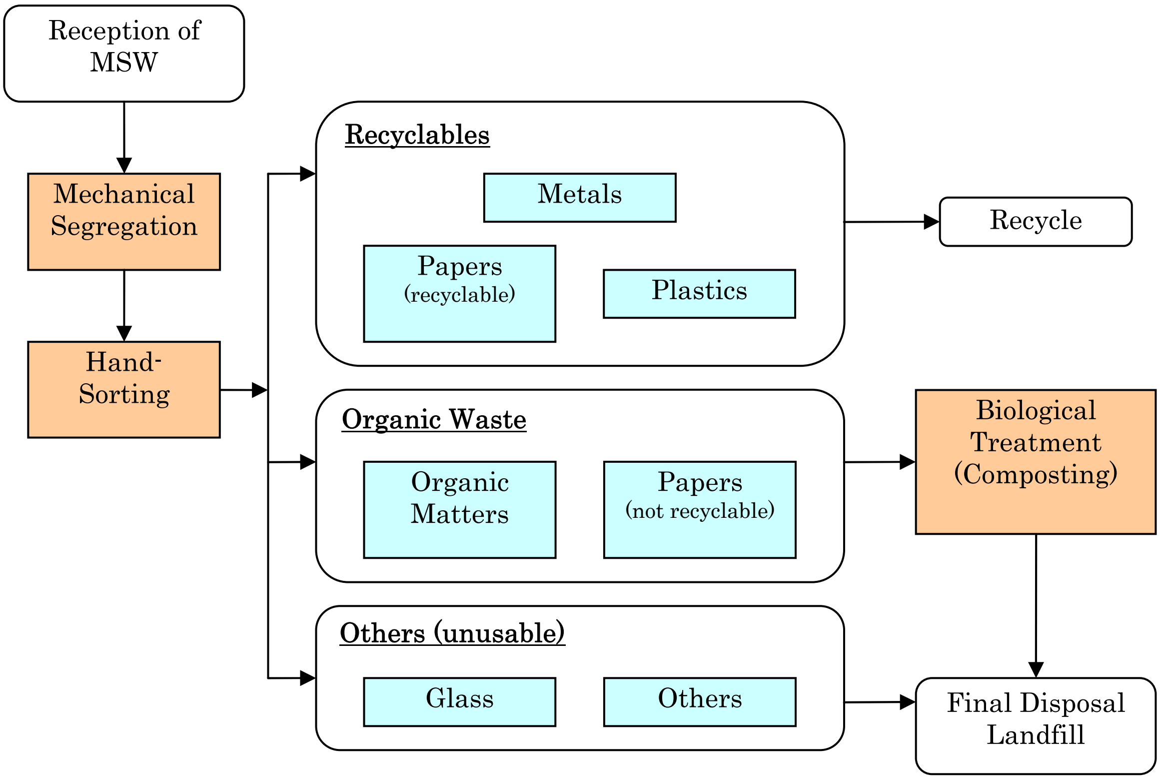


Figure 2: Schematic Diagram for the Treatment Process

A.4.4. Estimated amount of emission reductions over the chosen crediting period:

Table 1: Estimation of emission reduction

Year	**Annual estimation of emission reductions in tons of CO_2e**
2013	1,377
2014	2,534
2015	3,408
2016	4,084
2017	4,620
2018	5057
2019	5,420
2020	5,728
2021	5,996
2022	6,231
Total estimated reductions (tons of CO2e)	44,453
Total number of years in first crediting period	10
Annual average estimated reductions, first crediting period (tons of CO2e)	4,445

A.4.5. Public funding of the project activity:

This project will not receive any national or international funding for the development of the proposed project.

SECTION B. Application of a baseline and monitoring methodology

B.1. Title and reference of the approved baseline and monitoring methodology applied to the project activity:

Approved baseline and monitoring methodology applied to the project activity is:
AM0025 Version 12 ”Avoided emissions from organic waste through alternative waste treatment process”

Approved methodological tools applied to the project activities are:
“Tool for the demonstration and assessment of additionality” Version 05.2
“Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site - Version 05
“Tool to calculate the emission factor for an electricity system” Version 02

B.2. Justification of the choice of the methodology and why it is applicable to the project activity:

As stated in the methodology, the methodology is applicable to scenarios which involve one or a combination of the following waste treatment options.

a) A composting process in aerobic conditions;
b) Gasification to produce syngas and its use;
c) Anaerobic digestion with biogas collection and flaring and/or its use. The anaerobic digester processes only the waste for which emission reductions are claimed in this methodology. If the biogas is processed and upgraded to the quality of natural gas and it is distributed as energy via natural gas distribution grid, project activities may use approved methodology AM0053 in conjunction with this methodology. In such cases the baseline scenario identification procedure and additionality assessment shall be undertaken for the combination of the two components of the project activity i.e. biomethane emission avoidance and displacement of natural gas;
d) Mechanical/thermal treatment process to produce refuse-derived fuel (RDF)/stabilized biomass (SB) and its use. The thermal treatment process (dehydration) occurs under controlled conditions (up to 300 degrees Celsius). In case of thermal treatment process, the process shall generate a stabilized biomass that would be used as fuel or raw material in other industrial process. The physical and chemical properties of the produced RDF/SB shall be homogenous and constant over time;
e) Incineration of fresh waste for energy generation, electricity and/or heat. The thermal energy generated is either consumed on-site and/or exported to a nearby facility. Electricity generated is either consumed on-site, exported to the grid or exported to a nearby facility. The incinerator is rotating fluidized be or hearth or grate type.

The proposed project activity corresponds to a) a composting process in aerobic conditions. In addition, the proposed project satisfies the following requirements as described in the methodology.

Requirement	Project Condition
In case of composting, the produced compost is either used as soil conditioner or disposed of in landfills	The produced compost will be used as cover soil for landfill, that is, all the compost will be disposed of in the landfill.
The proportions and characteristics of different types of organic waste processed in the project activity can be determined, in order to apply a multiphase landfill gas generation model to estimate the quantity of landfill gas that would have been generated in the absence of the project activity	The proportions and characteristics of different types of organic waste processed in the project activity can be determined.
Waste handling in the baseline scenario shows a continuation of current practice of disposing waste in landfill despite environmental regulation that mandates the treatment of waste, if any, using any of the project activity mentioned above.	There are no laws, regulations, or government policies that restrict the disposal of MSW. Therefore the baseline scenario shows that the current practice of disposing waste in landfill without any treatment will be continued.
The compliance rate of the environmental regulation during (part of) the crediting period is below 50%, if monitored compliance with the MSW rules exceeds 50%, the project activity shall receive no further credit, since the assumption that the policy is not enforced is no longer tenable.	There are no regulations that mandate the intermediate treatment of waste before landfill in Malaysia. Therefore, the compliance rate does not need to be taken into account.
The project activity does not involve thermal treatment process of neither industrial or hospital waste.	The proposed project activity handles household waste and wastes from offices and markets. Therefore, neither industrial nor hospital waste is treated in the project activity.
This methodology is not applicable project activities that involve capture and flaring of methane from existing waste in the landfill. This should be treated as a separate project activity due to the difference in waste characteristics of existing and fresh waste, which may have an implication on the baseline scenario determination.	The proposed project does not involve landfill gas capture or flaring.

B.3. Description of the sources and gases included in the project boundary:

According to AM0025 version 12, the project boundary is the site of the project activity where the waste is segregated and composted as shown in the figure below. This includes the facilities for sorting, aerobic conversion and composting. The project boundary does not include facilities for waste collection, prior sorting (before reaching project site) nor transport to the project site.

The project activity avoids methane emissions by diverting organic waste to a MBT facility instead of dumping the waste at a landfill where methane emissions are generated due to anaerobic processes. Since the composting process is basically aerobic, no methane is generated. The GHG involved in the baseline and project emissions are CO_2, CH_4 and N_2O as shown in Table below.

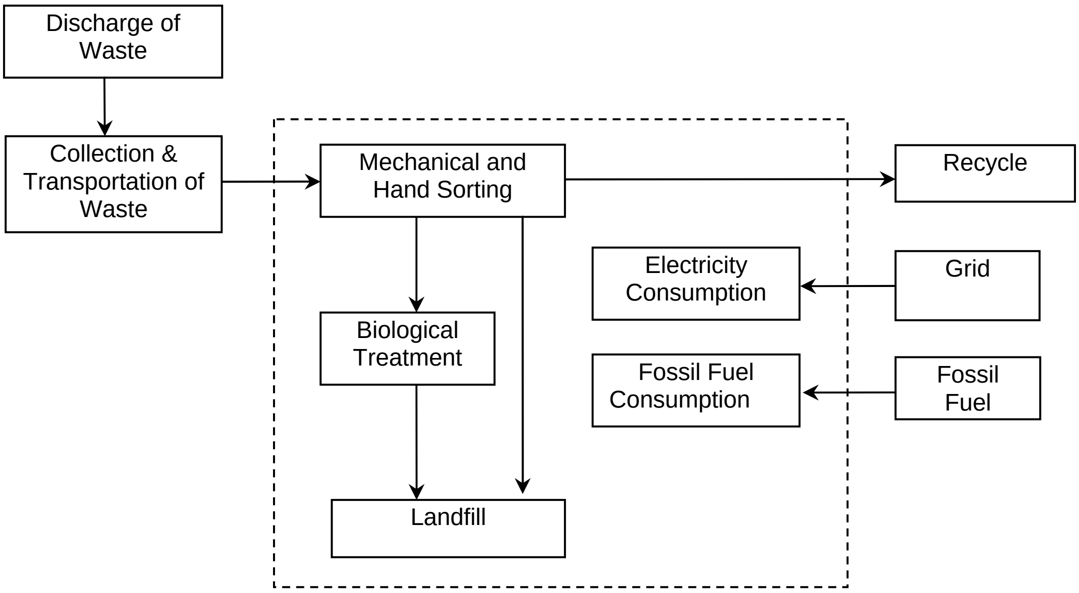


Figure 3: Project Boundary

The gases and sources relevant to the Project are listed below based on the AM0025 methodology.

Table 2: The Greenhouse Gases included in or excluded from the Project Boundary

	Source	Gas	Included?	Justification / Explanation
Baseline	Emissions from decomposition of waste at the landfill site	CH_4	Included	The major source of emissions in the baseline from the landfill.
		N_2O	Excluded	N_2O emissions are small compared to CH_4 emissions from landfills. This is conservative.
		CO_2	Excluded	Not accounted for.
	Emissions from electricity consumption	CO_2	Excluded	There is no electricity consumption at the project site in the absence of the project activity.
		CH_4	Excluded	Excluded for simplification. This is conservative.
		N_2O	Excluded	Excluded for simplification. This is conservative.
	Emissions from thermal energy generation	CO_2	Excluded	There is no thermal energy generation at the project site in the absence of the project activity.
		CH_4	Excluded	Excluded for simplification. This is conservative.
		N_2O	Excluded	Excluded for simplification. This is conservative.
Project Activity	On-site fossil fuel consumption due to the project activity other than for electricity	CO_2	Included	Fuel is consumed on-site for the vehicles and heavy equipments.
		CH_4	Excluded	Excluded for simplification. This emission source is assumed to be very small.
		N_2O	Excluded	Excluded for simplification. This emission source is assumed to be very small.

	Source	Gas	Included?	Justification / Explanation
	generation			
	Emissions from on-site electricity use	CO_2	Included	Electricity from the national grid is consumed on-site for the operation of the mechanical segregation system.
		CH_4	Excluded	Excluded for simplification. This emission source is assumed to be very small.
		N_2O	Excluded	Excluded for simplification. This emission source is assumed to be very small.
	Emissions from thermal energy generation	CO_2	Excluded	The project activity does not involve thermal energy generation.
		CH_4	Excluded	The project activity does not involve thermal energy generation.
		N_2O	Excluded	The project activity does not involve thermal energy generation.
	Direct emissions from the waste treatment processes	N_2O	Included	An important emission source for composting activities.
		CH_4	Included	The composting process may not be complete and result in anaerobic decay.
		CO_2	Excluded	Not included by methodology – CO_2 emissions from the decomposition of organic waste are not accounted.
	Direct emissions from the waste water treatment processes	CO_2	Excluded	CO_2 emissions from decomposition of organic waste are not accounted.
		CH_4	Excluded	There is no anaerobic waste water treatment in the project activity.
		N_2O	Excluded	There is no anaerobic waste water treatment in the project activity.

B.4. Description of how the baseline scenario is identified and description of the identified baseline scenario:

The baseline scenario is identified using the "Tool for the demonstration and assessment of additionality" and the procedures specified in the methodology AM0025.

Step 1. Identification of alternative scenarios

Sub-step 1a: Define alternatives to the project activity:

As per AM0025, version 12, alternatives for the disposal/treatment of the fresh waste in the absence of the project activity, i.e. the scenario relevant for estimating baseline methane emissions, to be analyzed should include, *inter alia*:

M1. The project activity not implemented as a CDM project;
M2. Disposal of waste at a landfill where landfill gas is captured and flared;

M3. Disposal of waste at a landfill without the capture of landfill gas.

The proposed project activity does not involve either power generation or heat utilization, hence the baseline scenarios for power (from P1 to P6) and heat (from H1 to H6) are not applicable.

Sub-step 1b: Consistency with mandatory laws and regulations:

In Malaysia, there are no laws, regulations, or government policies that specify or restrict certain types of treatment methods for MSW.
Therefore, all alternatives are in compliance with the mandatory laws and regulations that are set by the Government of Malaysia.

Step 2: Identify the fuel for the baseline choice of energy source taking into account the national and/or sectoral policies as applicable.

Since there is no power generation or heat utilization in the project activity, thus baseline does not involve fuel for energy. Therefore, this step is not applicable.

Step 3. Investment analysis

Since there are no mandatory laws or regulations that specify that the gases from the landfill must be captured and flared, there will be no public funding, money grants, or any sort of incentive for the installation of gas collection and flaring equipments. Therefore, it can be clearly stated that scenario M2 is economically unattractive, and shall be excluded from further consideration.

Scenario M1, or the proposed project activity implemented without the CDM related income, generates financial benefits from sales of recyclable materials, and saving in the cost of cover soil. The financial attractiveness of Scenario M1 will be determined.

Sub-step 3a. Determine appropriate analysis method:
The proposed project activity generates financial benefits other than the CDM related income from the sale of recyclable material, and benefit from saving in the cost of cover soil. The financial attractiveness of the proposed project activity will be determined by using Option Ⅲ, the benchmark analysis.

Sub-step 3b. OptionⅢ. Apply benchmark analysis:

The economic attractiveness of the proposed project activity (scenario M1) will be examined by using the benchmark analysis method. Internal Rate of Return (IRR) is deemed most suitable financial indicator for the proposed project and is compared to a benchmark value, which is Base Lending Rate issued by Bank Negara Malaysia which is 6.27 %[1]. (Issued December, 2010)

Sub-step 2c. Calculation and comparison of financial indicators:

---

[1] Bank Negara Malaysia, “Monthly Statistical Bulletin November 2010”, 2.1 Interest Rates , http://www.bnm.gov.my/index.php?ch=109&pg=294&mth=11&yr=2010&eId=box1

The IRR is calculated according to the following basic conditions.

Item	Description
Project Period	10 years
Annual operation days	300 days
Waste Amount	No change during the project (50t/d)
Amount of Loans	None
Inflation Rate	1.7% (as of 2010)[2]
Salary Increment Rate	4.10 %[3]
Corporate Tax	25%[4]
Depreciation Period	10 years[5]

Expense		Source
Initial Investment	4,368,650 RM	FSR
O&M Cost (Other than labour cost)	172,477 RM/year	FSR
Labour Cost	476,400 RM/year	FSR
Expense Total (10 years)	7,609,185 RM	FSR
Income		
Recyclables Sales	309,520 RM/year	FSR
Saving in the cost of cover soil (30 RM/ton)	152,850 RM/year	FSR
Income Total (10 years)	4,993,935 RM	FSR
Project IRR (10 years)	negative	FSR
Project IRR (20 years)	negative	FSR

As shown in the table above, the project IRR is negative, even taking into accounting the cost-saving benefit. This clearly indicates that an investment barrier exists in the projects implementation and the project is unattractive without CER revenue.

Sub-step 2d. Sensitivity analysis:

The purpose of sensitivity analysis is to examine whether the conclusion regarding the financial/ economic attractiveness is robust to reasonable variations in the critical assumptions.

The critical assumptions include:

i. Changes in investment cost
ii. Changes in O&M cost (maintenance & repair cost, fuel cost, electricity cost, etc.)
iii. Changes in Labour cost

---

[2] Department of Statistics Malaysia Official Website, Consumer Price Index Malaysia December 2010 (Updated: 19/01/2011) http://www.statistics.gov.my/portal/index.php?option=com_content&view=article&id=689&Itemid=61&lang=en

[3] Kelly Service, Inc., Employment Outlook and Salary Guide 2010/11

[4] Malaysia Industrial Development Authority (MIDA) Website, Invest in Malaysia,

[5] Malaysian Accounting Standards Board (MASB), MASB Approved Accounting Standards for Private Entities, MASB 14: Depreciation Accounting

iv. Changes in revenue from recyclables sales
v. Changes in benefit from saving in the cover soil cost

These parameters were selected as being the most likely to fluctuate over time due to external factors.

These factors were subjected to 10% variation (average plausible range) on either side, based on "Guidance on the Assessment of Investment Analysis, Version 03.1", Annex-58 of EB-51, to ascertain the impact on the profitability and hence the IRR of the project. The results of the sensitivity analysis are as given below:

Parameters	IRR (20 years)		
	Base Case	Increase by 10%	Decrease by 10%
Investment Cost	Negative	Negative	Negative
O&M Cost	Negative	Negative	Negative
Labour Cost	Negative	Negative	Negative
Revenue from recyclables sales	Negative	Negative	Negative
Saving in the cover soil cost	Negative	Negative	Negative

Thus, the sensitivity analysis for the projects reveals that even with significant changes in various parameters, the IRR of the project is negative or lower than the benchmark rates. Therefore, scenario M1 is economically unattractive, and shall be excluded from further consideration.

Scenario M3 represents the present status in Malaysia where MSW is disposed of in a landfill site without the capture of methane gas. Therefore, this scenario is business as usual.

Step 4. Where more than one credible and plausible alternative remains, project participants shall, as a conservative assumption, use the alternative baseline scenario that results in the lowest baseline emissions as the most likely baseline scenario. The least emission alternative will be identified for each component of the baseline scenario. In assessing these scenarios, any regulatory or contractual requirements should be taken into consideration.

In case of this project, only one credible and plausible alternative remains through the process from Step 1 to Step 3, so Step 4 is not applicable.

Through the assessment above, it is determined that the most plausible baseline scenario is M3 which is the disposal of waste at a landfill without the capture of methane gas.

B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity (assessment and demonstration of additionality):

The additionality of the project activity is demonstrated and assessed using the "Tool for the demonstration and assessment of additionality" Version. 05.2.

Serious Consideration of CDM

Annex 46 of EB 41 requires the serious consideration of the benefits to be demonstrated by a) the awareness of CDM by project participant prior to the project activity start date and b) parallel action having been taken for the registration of the project as CDM activity along with the implementation of the project. This proposed project falls under a).

The following chronology demonstrates the efforts taken by the project proponent in validation.

Date	Description of Events	Description of Evidence
August 2008	Outline of the project as a CDM explained to LT	Minutes of meeting
November 2008	Waste composition and aerobic treatment process tested toward CDM development by LT	Test report
August 2009	CDM FS financed by GEC began with full assistance by LT	Contract with GEC
August 2010	CDM procedures financed by GEC began with full assistance by LT	Contract with GEC
October 2010	Validation contract with DOE	Contract with DOE
January 2013	Project to start	

Step 1. Identification of alternatives to the project activity consistent with current laws and Regulations

Sub-step 1a. Define alternatives to the project activity:

From above analysis in B.4 Step1, the alternatives to the Project have been identified as follows:

M1. The project activity not implemented as a CDM project;
M2. Disposal of waste at a landfill where landfill gas is captured and flared;
M3. Disposal of waste at a landfill without the capture of landfill gas.

Sub-step 1b: Consistency with mandatory laws and regulations:

As stated in the previous section for assessment of the baseline scenario, there are no laws, regulations or government policies that specify or restrict certain types of treatment methods for MSW in Malaysia. All alternatives are in compliance with the mandatory applicable legal and regulatory requirements in Malaysia.

Based on the legal framework and common practice study in the B4, there is no any law or regulation mandates the treatment option of waste, further more, the landfill gas recovery and utilization is not common practice in Malaysia, so the alternative M2 can be eliminated. M1 and M3 go into step 2.

Step 2: Investment Analysis

The benchmark analysis is applied.

Sub-step 2a. Determine appropriate analysis method:

The proposed project activity generates financial benefits other than the CDM related income from the sale of recyclable material, and benefit from saving in the cost of cover soil. The financial attractiveness of Scenario M1 is as demonstrated in the previous section.

It can be concluded after applying the benchmark and sensitivity analysis that Scenario M1 is unlikely to be the most financially attractive scenario.

Step 3. Barrier analysis

According to the "Tool for the demonstration and assessment of additionality", the project developer could choose between Step 2 and Step3. As Step 2 shows already that there is a high financial barrier Step3 will not be described any further.

Step 4. Common practice analysis

Sub-step 4a. Analyze other activities similar to the proposed activity:

Composting of the organic component of MSW is a rather well-known technology. However, its implementation has been limited in Malaysia. To date, there is no commercial scale composting plant from MSW sources in Malaysia, due to unavailability of market for the produced compost, unavailability of a suitable budget and finance for operation & maintenance, and low economic feasibility of plants operation and maintenance which discourage the private sector invest in operating these plants. Although the Government of Malaysia encourages the composting of food wastes as part of their environmental measures, there are some very small-scale composting plants using agricultural and animal wastes only, which can produce composts with higher quality and thus can be sold at higher price compared to the compost from MSW. As for compost from MSW sources, there are only few composting projects funded by international organization and home-composting activities in schools and homes. Some examples are outlined in the table below:

Composting projects in Malaysia, other than the proposed project activity

Municipality	Implementing Agency	Quantity of waste treated (tonnes/year)	Notes

Kota Kinabalu[6]	MS SMART RECYLING (M) SDN BHD	500 tons/day	Funded by WB PDD has been submitted to CDM EB (not registered yet)
Seri Kembangan, Selangor (Pasar Borong Selangor)	Detik Aturan Sdn Bhd	-	Compost from agricultural wastes
Kampar, Perak	Kampar Municipal council	Home-composting by 200 households	Pilot projects by Kampar council
Sibu, Sarawak	Sibu Municipal Council	Home-composting by 150 households	

Therefore, composting activities similar to the proposed project in terms of scale, investment environment and technology have not been implemented in Malaysia, except for those being developed under CDM.

Sub-step 4b.Discuss any similar options that are occurring:
As stated in sub-step 4a, there are no similar options commonly occurring in Malaysia. The common practice in Malaysia is disposal of waste without any treatment or processing, and implementation of a composting project is difficult without additional incomes and investment.

In conclusion, the proposed project activity is economically unattractive, and it will not be implemented without the incentive provided by the CDM. Therefore, the proposed project activity is additional.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

Project Emissions

Project emissions are calculated using equation (1) provided in the methodology. $PE_{a,y}$, $PE_{g,y}$, $PE_{r,y}$, $PE_{i,y}$, $PE_{w,y}$ and $PE_{co\text{-}firing,y}$ are excluded from the calculation since the proposed project activity involves only composting.

$$PE_y = PE_{elec,y} + PE_{fuel,on-site,y} + PE_{c,y} \qquad (1)$$

Where:

PE_y	is the project emissions during the year y (tCO_2e/yr)
$PE_{elec,y}$	is the emissions from electricity consumption due to the project activity during the year y (tCO_2e/yr)
$PE_{fuel,on\text{-}site,y}$	is the emissions due to fuel consumption on-site in year y (tCO_2e/yr)
$PE_{c,y}$	is the emissions during the composting process in year y (tCO_2e/yr)

---

[6] MY-CF-Kota Kinabalu Composting Project

Emissions from electricity use ($PE_{elec,y}$)

The proposed project activity involves electricity consumption. The emissions from electricity consumption are calculated using equation (2).

$$PE_{elec,y} = EG_{PJ,EF,y} \times CEF_{elec} \tag{2}$$

Where:

$PE_{elec,y}$	is the emissions from electricity consumption due to the project activity during the year y (tCO_2e/yr)
$EG_{PJ,EF,y}$	is the amount of electricity generated in an on-site fossil fuel fired power plant or consumed from the grid in the project activity, measured using an electricity meter (MWh/yr)
CEF_{elec}	CO_2 emission factor for electricity generation in the project activity (tCO_2e/MWh)

The methodology states that in cases where the electricity is purchased from the grid, the emission factor CEF_{elec} should be calculated according to the “Tool to calculate the emission factor for an electricity system (Version 02)”. Accordingly, the emission factor has been calculated using the Tool mentioned above.

Emissions from fuel use on-site ($PE_{fuel,on\text{-}site,y}$)

The proposed project activity involves on-site fossil fuel consumption. The emissions from emissions from fossil fuel consumption on-site are calculated using equation (3).

$$PE_{fuel,on-site,y} = F_{cons,y} \times NCV_{fuel} \times EF_{fuel} \tag{3}$$

Where:

$PE_{fuel,on\text{-}site,y}$	is the CO_2 emissions due to on-site fuel combustion in year y (tCO_2e/yr)
$F_{cons,y}$	is the fuel consumption on site in year y (l/yr)
NCV_{fuel}	is the net calorific value of the fuel (MJ/l)
EF_{fuel}	is the CO_2 emission factor of the fuel (tCO_2e/MJ)

Emissions from Composting ($PE_{c,y}$)

Project emissions from composting are calculated using equation (4).

$$PE_{c,y} = PE_{c,N2O,y} + PE_{c,CH4,y} \tag{4}$$

Where:

$PE_{c,y}$	is the emissions during the composting process in year *y* (tCO_2e/yr)
$PE_{c,N2O,y}$	is the N_2O emissions during the composting process in year *y* (tCO_2e/yr)
$PE_{c,CH4,y}$	is the emissions during the composting process due to methane production through anaerobic conditions in year *y* (tCO_2e/yr)

N_2O emissions

The N_2O emissions during the composting process are calculated using equation (5).

$$PE_{c,N2O,y} = M_{compost,y} \times EF_{c,N2O} \times GWP_{N2O} \qquad (5)$$

Where:

$PE_{c,N2O,y}$	is the N_2O emissions during the composting process in year *y* (tCO_2e/yr)
$M_{compost,y}$	is the total quantity of compost produced in year *y* (tonnes/yr). Estimated values are used to ex-ante calculate the emission reduction.
$EF_{c,N2O}$	is the emission factor for N_2O from the composting process (tN_2O/t compost)
GWP_{N2O}	is the Global Warming Potential of nitrous oxide (tCO_2e/tN_2O)

CH_4 emissions

The CH_4 emissions during the composting process are calculated using equation (6).

$$PE_{c,CH4,y} = MB_{compost,y} \times S_{a,y} \qquad (6)$$

Where:

$PE_{c,CH4,y}$	is the project methane emissions due to anaerobic conditions in the composting process in year *y* (tCO_2e/yr)
$S_{a,y}$	is the share of the waste that degrades under anaerobic conditions in the composting plant during year *y* (%)
$MB_{compost,y}$	is the quantity of methane that would be produced in the landfill in the absence of the composting activity in year *y* (tCO_2e/yr). $MB_{compost,y}$ is estimated by multiplying MB_y (tCO_2e/yr) estimated from equation (10) by the fraction of waste diverted, from the landfill, to the composting activity (f_c) relative to the total waste diverted from the landfill to all project activities (composting, gasification, anaerobic digestion and RDF/stabilized biomass, incineration)

$S_{a,y}$ is calculated using equation (7).

$$S_{a,y} = S_{OD,y} / S_{total,y} \qquad (7)$$

Where:

$S_{a,y}$	is the share of the waste that degrades under anaerobic conditions in the composting plant during year *y* (%)

$S_{OD,y}$	is the number of samples per year with an oxygen deficiency (i.e. oxygen content below 10%)
$S_{total,y}$	is the total number of samples taken per year, where $S_{total,y}$ should be chosen in a manner that ensures the estimation of $S_{a,y}$ with 20% uncertainty at a 95% confidence level.

Baseline Emissions

Baseline emissions are calculated using equation (8) provided in the methodology.

$$BE_y = (MB_y - MD_{reg,y}) + BE_{EN,y} \tag{8}$$

Where:

BE_y	is the baseline emissions in year y (tCO_2e/yr)
MB_y	is the methane produced in the landfill in the absence of the project activity in year y (tCO_2e/yr)
$MD_{reg,y}$	is the methane that would be destroyed in the absence of the project activity in year y (tCO_2e/yr)
$BE_{EN,y}$	Baseline emissions from generation of energy displaced by the project activity in year y (tCO_2/yr)

Adjustment Factor (AF)

Since regulatory or contractual requirements do not specify $MD_{reg,y}$ in the proposed project activity, Adjustment Factor (AF) will be used to determine the methane that would be destroyed in the absence of the project activity.

$$MD_{reg,y} = MB_y \times AF \tag{9}$$

Where:

AF	is Adjustment Factor for MB_y (%)

Rate of Compliance

There are no laws or regulations that mandate the use of the one of the treatment options in Malaysia. Therefore, method for adjusting the baseline emissions by rate of compliance does not apply.

Methane generation from the landfill in the absence of the project activity (MB_y)

The amount of methane that is generated each year (MB_y) is calculated as per the “Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site”, considering the following equation:

$$MB_y = BE_{CH4,SWDS,y} \tag{10}$$

$$BE_{CH4,SWDS,y} = \varphi \cdot (1-f) \cdot GWP_{CH4} \cdot (1-OX) \cdot \frac{16}{12} \cdot F \cdot DOC_f \cdot MCF \cdot \sum_{x=1}^{y} \sum_{j} W_{j,x} \cdot DOC_j \cdot e^{-kj \cdot (y-x)} \cdot \left(1-e^{-kj}\right) \tag{11}$$

Where:

MB_y	is $BE_{CH4,SWDS,y}$ (tCO_2e/yr)
$BE_{CH4,SWDS,y}$	is the methane generation from the landfill in the absence of the project activity at year y that is methane emissions avoided during the year y from preventing waste disposal at the solid waste disposal site (SWDS) during the period from the start of the project activity to the end of the year y (tCO_2e/yr)
φ	is the model correction factor to account for model uncertainties (0.9)
f	is the fraction of methane captured at the SWDS and flared, combusted or used in another manner
GWP_{CH4}	is the Global Warming Potential (GWP) of methane, valid for the relevant commitment period
OX	is the oxidation factor (reflecting the amount of methane from SWDS that is oxidised in the soil or other material covering the waste)
F	is the fraction of methane in the SWDS gas (volume fraction) (0.5)
DOC_f	is the fraction of degradable organic carbon (DOC) that can decompose
MCF	is the methane correction factor
$W_{j,x}$	is the amount of organic waste type j prevented from disposal in the SWDS in the year x (tonnes)
DOC_j	is the fraction of degradable organic carbon (by weight) in the waste type j
k_j	is the decay rate for the waste type j
j	is the waste type category (index)
x	is the year during the crediting period: x runs from the first year of the first crediting period (x=1) to year y for which avoided emissions are calculated (x=y)
y	is the year for which methane emissions are calculated

$$W_{j,x} = W_x \times \frac{\sum_{n=1}^{z} P_{n,j,x}}{z} \tag{12}$$

Where:

$W_{j,x}$	is the amount of organic waste type j prevented from disposal in the SWDS in the year x (tonnes)
W_x	is the total amount of organic waste prevented from disposal in year x (tonnes)
$P_{n,j,x}$	is the weight fraction of the waste type j in the sample n collected during the year x
z	is the number of samples collected during the year x

Baseline emissions from generation of electricity
This section is not applicable since the proposed project activity does not involve any electricity generation.

Baseline emissions from electricity and heat cogeneration
This section is not applicable since the proposed project activity does not involve cogeneration by electricity or heat.

Leakage

The leakage emissions of the proposed project activity are estimated using equation (13). $L_{i,y}$ (leakage emissions from the residual waste from MSW incinerator in year *y*) and $L_{s,y}$ (leakage emissions from end use of stabilized biomass in year *y*) are excluded from the equation since the proposed project activity is composting of organic waste:

$$L_y = L_{t,y} + L_{r,y} \tag{13}$$

Where:

L_y	is the leakage emissions during the year *y* (tCO_2e/yr)
$L_{t,y}$	is the leakage emissions from increased transport in year *y* (tCO_2e/yr)
$L_{r,y}$	is the leakage emissions from the residual waste from the anaerobic digester, the gasifier, the processing/combustion of RDF/stabilized biomass, or compost in case it is disposed of in landfills in year *y* (tCO_2/yr)

Emissions from Transportation ($L_{t,y}$)
This would occur when the waste is transported from waste collecting points, in the collection area, to the treatment facility, instead of the existing landfills. The emissions are calculated from the quantity of fuel used and the specific CO2 emissions factor of the fuel.

$$L_{t,y} = \sum_{i}^{n} NO_{vehicles,i,y} \ x \ DT_{i,y} \ x \ VF_{cons,i} \ x \ NCV_{fuel} \ x \ D_{fuel} \ x \ EF_{fuel} \tag{14}$$

Where:

$NO_{vehicles,i,y}$	is the number of vehicles for transport with similar loading capacity
$DT_{i,y}$	is the average additional distance travelled by vehicle type i compared to baseline in year y (km)
$VF_{cons,I}$	is the vehicle fuel consumption in litres per kilometre for vehicle type *i* (l/km)
NCV_{fuel}	is the Calorific value of the fuel (MJ/Kg or other unit)
D_{fuel}	is the fuel density (kg/l), if necessary
EF_{fuel}	is the Emission factor of the fuel (tCO_2/MJ)

The land used for producing compost is located within the landfill site where the waste is currently transported for disposal. Therefore, there is no increase of transportation related to the proposed project activity, and there is no leakage emissions associated with this.

Hence, the only leakage emission from the proposed project activity is the leakage emission from compost which will be disposed of in the landfill.

Emissions from compost ($L_{s,y}$)

In the proposed project activity, all the compost produced will be disposed of in the landfill site. Therefore, CH_4 emissions from the compost are estimated through equation (11) using estimated weights of each waste type ($A_{ci,x}$).

Emission Reduction

The emission reductions are calculated by applying the following equation.

$$ER_y = BE_y - PE_y - L_y \qquad (15)$$

Where:

ER_y	is the emissions reductions in year *y* (tCO_2e/yr)
BE_y	is the emissions in the baseline scenario in year *y* (tCO_2e/yr)
PE_y	is the emissions in the project scenario in year *y* (tCO_2e/yr)
L_y	is the leakage in year *y* (tCO_2e/yr)

B.6.2. Data and parameters that are available at validation:

(Copy this table for each data and parameter)

Data / Parameter:	***CEF_{elec}***
Data unit:	tCO_2e/MWh
Description:	The emission factor for electricity generation corresponding to electricity used in the project activity.
Source of data used:	
Value applied:	0.684
Justification of the choice of data or description of measurement methods and procedures actually applied :	Calculated based on the "*Tool to calculate the emission factor for an electricity system*" (*Version 1.1*)", as demonstrated in the "Study on Grid Connected Electricity Baselines in Malaysia: 2006 & 2007" (Version 2.0) published by the Malaysia Energy Centre in December 2008.
Any comment:	

Data / Parameter:	***NCV_{fuel}***
Data unit:	MJ/l
Description:	Net calorific value of fuel
Source of data used:	2006 IPCC Guidelines for National Greenhouse Gas Inventories

Value applied:	36.3
Justification of the choice of data or description of measurement methods and procedures actually applied :	Adjusted by multiplying 0.844 kg/l (density of diesel) to the NCV value in TJ/Gg (43.0 TJ/Gg) provided for Gas/Diesel in the IPCC guideline.
Any comment:	

Data / Parameter:	EF_{fuel}
Data unit:	tCO_2e/MJ
Description:	Emission factor for the fuel
Source of data used:	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value applied:	0.000074
Justification of the choice of data or description of measurement methods and procedures actually applied :	Diesel is a standard fuel, for which IPCC is a reliable data source.
Any comment:	

Data / Parameter:	$EF_{C,N2O}$
Data unit:	tN_2O/t compost
Description:	Emission factor for N_2O from the composting process
Source of data used:	AM0025
Value applied:	0.000043
Justification of the choice of data or description of measurement methods and procedures actually applied :	Default value given in the approved methodology AM0025, based on Schenk et al., 1997
Any comment:	

Data / Parameter:	GWP_{N2O}
Data unit:	-
Description:	Global Warming Potential of nitrous oxide
Source of data used:	Decisions under UNFCCC and the Kyoto Protocol
Value applied:	310
Justification of the choice of data or description of measurement methods and procedures actually applied :	Decisions under UNFCCC and the Kyoto Protocol (a value of 310 is to be applied for the first commitment period of the Kyoto Protocol)
Any comment:	

Data / Parameter:	GWP_{CH4}
Data unit:	-
Description:	Global Warming Potential of methane
Source of data used:	Decisions under UNFCCC and the Kyoto Protocol
Value applied:	21
Justification of the choice of data or description of measurement methods and procedures actually applied :	Decisions under UNFCCC and the Kyoto Protocol (a value of 21 is to be applied for the first commitment period of the Kyoto Protocol)
Any comment:	

Data / Parameter:	f_C
Data unit:	%
Description:	Fraction of waste diverted, from the landfill to all project activity (composting)
Source of data to be used:	Plant records
Value applied:	100
Justification of the choice of data or description of measurement methods and procedures actually applied :	All the collected organic waste are diverted to aerobic treatment.
Any comment:	

Data / Parameter:	AF
Data unit:	%
Description:	Adjustment factor for $MB_{reg,y}$
Source of data used:	Estimation
Value applied:	0
Justification of the choice of data or description of measurement methods and procedures actually applied :	There are no laws, regulations, or government policies that mandate the destruction of SWDS gas, and activity to collect or destruct SWDS gas is not expected at the target landfill site. Therefore, $MD_{reg,y}$ is expected to be 0 through out the crediting period.
Any comment:	Changes in regulatory requirements relating to the baseline landfill will be monitored to update the adjustment factor at the beginning of each crediting period. However, the proposed project uses fixed crediting period, the value for AF at the registration of the project will be used for the entire project period.

Data / Parameter:	φ
Data unit:	-
Description:	Model correction factor to account for model uncertainties of the “Tool to

	determine methane emissions avoided from dumping waste at a solid waste disposal site”
Source of data used:	“Tool to determine the methane emissions avoided from dumping waste at a solid waste disposal site”
Value applied:	0.9
Justification of the choice of data or description of measurement methods and procedures actually applied :	A default value provided in the “Tool to determine methane emission avoided from disposal of waste at a solid waste disposal site”.
Any comment:	

Data / Parameter:	***f***
Data unit:	-
Description:	Fraction of methane captured at the SWDS and flared, combusted or used in another manner
Source of data used:	AM0025
Value applied:	0
Justification of the choice of data or description of measurement methods and procedures actually applied :	Already accounted for as AF (Adjustment Factor)
Any comment:	

Data / Parameter:	***OX***
Data unit:	-
Description:	Oxidation Factor (reflecting the amount of methane from SWDS that is oxidized in the soil or other material covering the waste)
Source of data used:	Assessed according to site visit and the “Tool to determine the methane emissions avoided from dumping waste at a solid waste disposal site”
Value applied:	0.1
Justification of the choice of data or description of measurement methods and procedures actually applied :	The site for the proposed project activity is a managed solid waste disposal site that is covered with soil.
Any comment:	

Data / Parameter:	***F***
Data unit:	-
Description:	Fraction of methane in the SWDS gas (volume fraction)
Source of data used:	“Tool to determine the methane emissions avoided from dumping waste at a solid waste disposal site”

Value applied:	0.5
Justification of the choice of data or description of measurement methods and procedures actually applied :	A default value recommended by the IPCC 2006 Guidelines for National Greenhouse Gas Inventories.
Any comment:	

Data / Parameter:	***DOC_f***
Data unit:	-
Description:	Fraction of degradable organic carbon (DOC) that can decompose
Source of data used:	"Tool to determine the methane emissions avoided from dumping waste at a solid waste disposal site"
Value applied:	0.5
Justification of the choice of data or description of measurement methods and procedures actually applied :	A default value recommended by the IPCC 2006 Guidelines for National Greenhouse Gas Inventories.
Any comment:	

Data / Parameter:	***MCF***
Data unit:	-
Description:	Methane correction factor
Source of data used:	"Tool to determine the methane emissions avoided from dumping waste at a solid waste disposal site"
Value applied:	1.0
Justification of the choice of data or description of measurement methods and procedures actually applied :	Value applied for anaerobic managed solid waste disposal sites – It has controlled placement of waste. Waste directed to specific deposition area and will include : (i) cover material and, (ii) mechanical compacting
Any comment:	

Data / Parameter:	***DOC_j***
Data unit:	-
Description:	Fraction of degradable organic carbon (by weight) in the waste type *j*
Source of data used:	"Tool to determine the methane emissions avoided from dumping waste at a solid waste disposal site"

Value applied:	Following values are applied for each waste type *j* according to the values provided in the "Tool to determine the methane emissions avoided from dumping waste at a solid waste disposal site".

Waste Type *j*	DOC_j (% wet waste)	DOC_j (% dry waste)
Food	15	38
Garden	20	49
Wood and Straw	43	50
Paper	40	44
Textiles	24	30
Disposable nappies	24	30

Justification of the choice of data or description of measurement methods and procedures actually applied :	As per the "Tool to determine the methane emissions avoided from dumping waste at a solid waste disposal site".
Any comment:	

Data / Parameter:	***k_j***
Data unit:	-
Description:	Decay rate for the waste type j
Source of data used:	"Tool to determine the methane emissions avoided from dumping waste at a solid waste disposal site"
Value applied:	Following values are applied for each waste type *j* according to the values provided in the "Tool to determine the methane emissions avoided from dumping waste at a solid waste disposal site". The conditions for the project site is tropical (MAT>20℃) and wet (MAP>1000mm), and the decomposition of waste is very fast (Rapidly degrading).

Waste Type *j*	Tropical (MAT>20℃) Wet (MAP>1000mm)
Food	0.4
Garden	0.17
Wood and Straw	0.035
Paper	0.07
Textiles	0.07
Disposable nappies	0.17

Justification of the choice of data or description of measurement methods and procedures actually applied :	As per the "Tool to determine the methane emissions avoided from dumping waste at a solid waste disposal site".
Any comment:	

B.6.3. Ex-ante calculation of emission reductions:

Project Emissions

$$PE_y = PE_{elec,y} + PE_{fuel,on-site,y} + PE_{c,y} \qquad (1)$$

Where:

PE_y	is the project emissions during the year y (tCO_2e/yr)
$PE_{elec,y}$	is the emissions from electricity consumption due to the project activity during the year y (tCO_2e/yr)
$PE_{fuel,on-site,y}$	is the emissions on-site due to fuel consumption on-site in year y (tCO_2e/yr)
$PE_{c,y}$	is the emissions during the composting process in year y (tCO_2e/yr)

PE_y	$PE_{elec,y}$	$PE_{fuel,on-site,y}$	$PE_{c,y}$
tCO_2e/yr	tCO_2e/yr	tCO_2e/yr	tCO_2e/yr
189	20	102	67.9

Emissions from electricity use ($PE_{elec,y}$)

$$PE_{elec,y} = EG_{PJ,EF,y} \times CEF_{elec} \qquad (2)$$

Where:

$PE_{elec,y}$	is the emissions from electricity consumption due to the project activity during the year y (tCO_2e/yr)
$EG_{PJ,EF,y}$	is the amount of electricity generated in an on-site fossil fuel fired power plant or consumed from the grid in the project activity, measured using an electricity meter (MWh)
CEF_{elec}	CO_2 emission factor for electricity generation in the project activity (tCO_2e/MWh)

$PE_{elec,y}$	$EG_{PJ,EF,y}$	CEF_{elec}
tCO_2e/yr	MWh	tCO_2e/MWh
20	28.78	0.684

Emissions from fuel use on-site ($PE_{fuel,on-site,y}$)

$$PE_{fuel,on-site,y} = F_{cons,y} \times NCV_{fuel} \times EF_{fuel} \qquad (3)$$

Where:

$PE_{fuel,on-site,y}$	is the CO_2 emissions due to on-site fuel combustion in year y (tCO_2/yr)
$F_{cons,y}$	is the fuel consumption on site in year y (t)
NCV_{fuel}	is the net calorific value of the fuel (MJ/t)

EF_{fuel} is the CO_2 emission factor of the fuel (tCO_2/MJ)

$PE_{fuel,on-site,y}$	$F_{cons,y}$	NCV_{fuel}	EF_{fuel}
tCO_2e/yr	t	MJ/t	tCO_2e/MJ
102	31.7	43,330	0.000074

Emissions from Composting ($PE_{c,y}$)

$$PE_{c,y} = PE_{c,N2O,y} + PE_{c,CH4,y} \tag{4}$$

Where:

$PE_{c,y}$ is the emissions during the composting process in year *y* (tCO_2e/yr)

$PE_{c,N2O,y}$ is the N_2O emissions during the composting process in year *y* (tCO_2e/yr)

$PE_{c,CH4,y}$ is the emissions during the composting process due to methane production through anaerobic conditions in year *y* (tCO_2e/yr)

$PE_{c,y}$	$PE_{c,N2O,y}$	$PE_{c,CH4,y}$
tCO_2e/yr	tCO_2e/yr	tCO_2e/yr
67.9	67.9	0

N_2O emissions

$$PE_{c,N2O,y} = M_{compost,y} \times EF_{c,N2O} \times GWP_{N2O} \tag{5}$$

Where:

$PE_{c,N2O,y}$ is the N_2O emissions during the composting process in year *y* (tCO_2e/yr)

$M_{compost,y}$ is the total quantity of compost produced in year y (tonnes/yr)

$EF_{c,N2O}$ is the emission factor for N_2O from the composting process (tN_2O/t compost)
Approved value of 0.000043 tN_2O/t compost has been used.

GWP_{N2O} is the Global Warming Potential of nitrous oxide, (tCO_2/tN_2O)

$PE_{c,N2O,y}$	$M_{compost,y}$	$EF_{c,N2O}$	GWP_{N2O}
tCO_2e/yr	tonnes/yr	tN_2O/t compost	tCO_2e/tN_2O
67.9	5,095	0.000043	310

CH_4 emissions

$$PE_{c,CH4,y} = MB_{compost,y} \times S_{a,y} \tag{6}$$

Where:

$PE_{c,CH4,y}$ is the project methane emissions due to anaerobic conditions in the composting process in year *y* (tCO_2e/yr)

$S_{a,y}$ is the share of the waste that degrades under anaerobic conditions in the composting plant during year *y* (%)

$MB_{compost,y}$ is the quantity of methane that would be produced in the landfill in the absence of the composting activity in year y (tCO2e/yr). $MB_{compost,y}$ is estimated by MB_y estimated from equation 10 by the fraction of waste diverted, from the landfill, to the composting activity (f_c) relative to the total waste diverted from the landfill to all project activities (composting, gasification, anaerobic digestion and RDF/stabilized biomass, incineration). In the Project, all the collected MSW is treated on composting process, f_c = 100%.

$PE_{c,CH4,y}$	$S_{a,y}$	$MB_{compost,y}$
tCO_2e/yr	%	tCO_2e/yr
0	0	*Referring to* MB_y

$$S_{a,y} = S_{OD,y} / S_{total,y} \qquad (7)$$

Where:

$S_{a,y}$ is the share of the waste that degrades under anaerobic conditions in the composting plant during year *y* (%)

$S_{OD,y}$ is the number of samples per year with an oxygen deficiency (i.e. oxygen content below 10%)

$S_{total,y}$ is the total number of samples taken per year, where $S_{total,y}$ should be chosen in a manner that ensures the estimation of $S_{a,y}$ with 20% uncertainty at a 95% confidence level.

$S_{a,y}$	$S_{OD,y}$	$S_{total,y}$
%	-	-
0	0	0

Baseline Emissions

$$BE_y = MB_y - MD_{reg,y} + BE_{EN,y} \qquad (8)$$

Where:

BE_y is the baseline emissions in year *y* (tCO_2e/yr)

MB_y is the methane produced in the landfill in the absence of the project activity in year *y* (tCO_2e/yr)

$MD_{reg,y}$ is the methane that would be destroyed in the absence of the project activity in year *y* (tCO_2e/yr)

$BE_{EN,y}$ Baseline emissions from generation of energy displaced by the project activity in year *y* (tCO_2e/yr)

Year *y*	BE_y	MB_y	$MD_{reg,y}$	$BE_{EN,y}$
	tCO_2e/yr	tCO_2e/yr	tCO_2e/yr	tCO_2e/yr

2013	2,635	2,635	0	0
2014	4,589	4,589		
2015	6,071	6,071		
2016	7,222	7,222		
2017	8,139	8,139		
2018	8,888	8,888		
2019	9,513	9,513		
2020	10,047	10,047		
2021	10,510	10,510		
2022	11,919	11,919		

Adjustment Factor (AF)

$$MD_{reg,y} = MB_y \times AF \qquad (9)$$

Where:

AF	is the Adjustment Factor for MB_y (%)

$MD_{reg,y}$	MB_y	AF
tCO_2e/yr	tCO_2e/yr	%
0	See table above	0

Methane generation from the landfill in the absence of the project activity (MB_y)

$$MB_y = BE_{CH4,SWDS,y} \qquad (10)$$

$$BE_{CH4,SWDS,y} = \varphi \cdot (1-f) \cdot GWP_{CH4} \cdot (1-OX) \cdot \frac{16}{12} \cdot F \cdot DOC_f \cdot MCF \cdot \sum_{x=1}^{y} \sum_{j} W_{j,x} \cdot DOC_j \cdot e^{-kj \cdot (y-x)} \cdot \left(1-e^{-kj}\right)$$

(11)

Where:

MB_y	is $BE_{CH4,SWDS,y}$ (tCO_2e/yr)
$BE_{CH4,SWDS,y}$	is the methane emissions avoided during the year y from preventing waste disposal at the solid waste disposal site (SWDS) during the period from the start of the project activity to the end of the year y (tCO_2e/yr)
φ	is the model correction factor to account for model uncertainties (0.9)
f	is the fraction of methane captured at the SWDS and flared, combusted or used in another manner
GWP_{CH4}	is the Global Warming Potential (GWP) of methane, valid for the relevant commitment period

OX	is the oxidation factor (reflecting the amount of methane from SWDS that is oxidised in the soil or other material covering the waste)
F	is the fraction of methane in the SWDS gas (volume fraction) (0.5)
DOC_f	is the fraction of degradable organic carbon (DOC) that can decompose
MCF	is the methane correction factor
$W_{j,x}$	is the amount of organic waste type *j* prevented from disposal in the SWDS in the year *x* (tonnes)
DOC_j	is the fraction of degradable organic carbon (by weight) in the waste type *j*
k_j	is the decay rate for the waste type *j*
j	is the waste type category (index)
x	is the year during the crediting period: *x* runs from the first year of the first crediting period (*x*=1) to year *y* for which avoided emissions are calculated (*x*=*y*)
y	is the year for which methane emissions are calculated

$$W_{j,x} = W_x \times \frac{\sum_{n=1}^{z} P_{n,j,x}}{z} \tag{12}$$

Where:

$W_{j,x}$	is the amount of organic waste type *j* prevented from disposal in the SWDS in the year *x* (tonnes)
W_x	is the total amount of organic waste prevented from disposal in year *x* (tonnes)
$P_{n,j,x}$	is the weight fraction of the waste type *j* in the sample *n* collected during the year *x*
z	is the number of samples collected during the year *x*

Year *y*	MB_y	$BE_{CH4,SWDS,y}$
	tCO_2e/yr	tCO_2e/yr
2013	2,635	2,635
2014	4,589	4,589
2015	6,071	6,071
2016	7,222	7,222
2017	8,139	8,139
2018	8,888	8,888
2019	9,513	9,513
2020	10,047	10,047
2021	10,510	10,510
2022	11,919	11,919

φ	f	GWP_{CH4}	OX	F	DOC_f	MCF
-	-	-	-	-	-	-
0.9	0	21	0.1	0.5	0.5	1.0

Waste type *j*	$W_{j,x}$	DOC_j	k_j

	tons/yr	%	1/yr
Food	6,554	0.15	0.4
Garden	1,500	0.20	0.17
Wood and Straw	1.109	0.43	0.035
Paper	2,624	0.40	0.07
Textile	563	0.24	0.07

Year	W_x
	tons/yr
2013	18,250
2014	18,250
2015	18,250
2016	18,250
2017	18,250
2018	18,250
2019	18,250
2020	18,250
2021	18,250
2022	18,250

Waste Type	$P_{n,j,x}$
	%
Food	36
Garden	8
Paper	14
Wood and Straw	6
Textile	3
Plastics, other inert	32

The waste composition considered for the calculations is a result of investigation made in 2009 by Midac CO., LTD. The references are attached under the “Waste composition analysis” section in Annex 3.

Baseline emissions from generation of electricity displaced by the project activity
This section is not applicable since the proposed project activity does not involve any electricity generation.

Baseline emissions from electricity and heat cogeneration that is displaced by the project activity
This section is not applicable since the proposed project activity does not involve electricity or heat cogeneration.

Leakage

$$L_y = L_{t,y} + L_{r,y} + L_{s,y} \tag{13}$$

Where:

L_y	is the leakage emissions during the year y (tCO_2e/yr)
$L_{t,y}$	is the leakage emissions from increased transport in year y (tCO_2e/yr)
$L_{r,y}$	is the leakage emissions from the residual waste from the anaerobic digester, the gasifier, the processing/combustion of RDF/stabilized biomass, or compost in case it is disposed of in landfills in year y (tCO_2e/yr)
$L_{s,y}$	is the leakage emissions from end use of compost in year y (tCO_2e/yr)

Emissions from Transportation ($L_{t,y}$)

$$L_{t,y} = \sum_{i}^{n} NO_{vehicles,i,y} \text{ x } DT_{i,y} \text{ x } VF_{cons,i} \text{ x } NCV_{fuel} \text{ x } D_{fuel} \text{ x } EF_{fuel} \qquad (14)$$

Where:

$NO_{vehicles,i,y}$	is the number of vehicles for transport with similar loading capacity
$DT_{i,y}$	is the average additional distance travelled by vehicle type i compared to baseline in year y (km)
$VF_{cons,I}$	is the vehicle fuel consumption in litres per kilometre for vehicle type *i* (l/km)
NCV_{fuel}	is the Calorific value of the fuel (MJ/Kg or other unit)
D_{fuel}	is the fuel density (kg/l), if necessary
EF_{fuel}	is the Emission factor of the fuel (tCO_2/MJ)

The land used for producing compost is located within the landfill site where the waste is currently transported for disposal. Therefore, there is no increase of transportation related to the proposed project activity, and there is no leakage emissions associated with this.

Emissions from compost ($L_{s,y}$)

The amount of compost products is estimated as the Table below, and all the compost produced in the proposed project activity will be disposed of in the landfill site.
To be conservative, it is assumed that the compost waste consists of the original input waste to composting (only pulp, food waste, because other types have been taken out by sorting) as follows:

Year	$M_{compost,y}$
	tons/yr
2013	5,095
2014	5,095
2015	5,095
2016	5,095
2017	5,095
2018	5,095
2019	5,095
2020	5,095
2021	5,095
2022	5,095

Waste Type	$A_{ci,x}$	$P_{n,j,x}$
	tons/yr	%
Food	2,622	51
Garden	599	12
Paper	1,132	22
Wood and Straw	444	9
Textile	225	4
Plastics, other inert	73	2
Total	5.095	100

The references are attached under the “Calculating waste composition of compost” section in Annex 3.

The calculation results are as in following table:

Year *y*	L_y	$L_{t,y}$	$L_{r,y}$	$L_{s,y}$
	tCO_2e/yr	tCO_2e/yr	tCO_2e/yr	tCO_2e/yr
2013	1,069	0	1,069	0
2014	1,866	0	1,866	0
2015	2,474	0	2,474	0

2016	2,949	0	2,949	0
2017	3,330	0	3,330	0
2018	3,642	0	3,642	0
2019	3,905	0	3,905	0
2020	4,219	0	4,219	0
2021	4,325	0	4,325	0
2022	4,499	0	4,499	0

Emission Reduction

$$ER_y = BE_y - PE_y - L_y \quad (15)$$

Where:

ER_y	is the emissions reductions in year y (tCO_2e/yr)
BE_y	is the emissions in the baseline scenario in year y (tCO_2e/yr)
PE_y	is the emissions in the project scenario in year y (tCO_2e/yr)
L_y	is the leakage in year y (tCO_2e/yr)

B.6.4 Summary of the ex-ante estimation of emission reductions:

The ex-ante emission reductions throughout the crediting period are estimated as below:

Year y	ER_y	BE_y	PE_y	L_y
	tCO_2e/yr	tCO_2e/yr	tCO_2e/yr	tCO_2e/yr
2013	1,377	2,635	189	1,069
2014	2,534	4,589	189	1,866
2015	3,408	6,071	189	2,474
2016	4,084	7,222	189	2,949
2017	4,620	8,139	189	3,330
2018	5057	8,888	189	3,642
2019	5,420	9,513	189	3,905
2020	5,728	10,047	189	4,219
2021	5,996	10,510	189	4,325
2022	6,231	11,919	189	4,499

B.7. Application of the monitoring methodology and description of the monitoring plan:

B.7.1 Data and parameters monitored:

(Copy this table for each data and parameter)

Data / Parameter:	$EG_{PJ,EF,y}$

Data unit:	MWh/year
Description:	The amount of electricity consumed from the grid in the project activity.
Source of data to be used:	Measurements at the composting facility and metering data from the electric company.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	28.78 MWh /year
Description of measurement methods and procedures to be applied:	Electricity consumption will be measure by an electric meter of the composting facility.
Monitoring frequency	Continuous
QA/QC procedures to be applied:	The electric meter will be checked periodically to test the accuracy of its measurement. The data will be double checked with the electric company.
Any comment:	

Data / Parameter:	***CEF_{elec}***
Data unit:	tCO_2e/MWh
Description:	Emission factor for the production of electricity used in the project activity
Source of data to be used:	Official utility documents to measure the electricity consumed at the site and the “Tool to Calculate the Emission Factor for an Electricity System Version 02” has been used to work out the national grid emission factor, since the project activity is taking electricity from the national grid for onsite consumption.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.684
Description of measurement methods and procedures to be applied:	Calculated based on the “*Tool to calculate the emission factor for an electricity system*” (*Version 1.1*)”, as demonstrated in the “Study on Grid Connected Electricity Baselines in Malaysia: 2006 & 2007” (Version 2.0) published by the Malaysia Energy Centre in December 2008.
Monitoring frequency	*Ex-ante* (start of the crediting period)
QA/QC procedures to be applied:	Calculated as per appropriate methodology at start of crediting period
Any comment:	

Data / Parameter:	***$F_{cons,y}$***
Data unit:	tons/year
Description:	The diesel fuel consumption for equipment used in the composting process
Source of data to be used:	Fuel purchase invoice and/or metering
Value of data applied for the purpose of	31.7 tons

calculating expected emission reductions in section B.5	
Description of measurement methods and procedures to be applied:	Original invoices for fuel purchases would be kept by paper as well as electronic data by SPC.
Monitoring frequency	Continuous
QA/QC procedures to be applied:	Consistency between the original invoice and the accumulated electronic data will be checked periodically.
Any comment:	

Data / Parameter:	NCV_{fuel}
Data unit:	MJ/l
Description:	Net calorific value of fuel
Source of data to be used:	IPCC
Value of data applied for the purpose of calculating expected emission reductions in section B.5	36.3
Description of measurement methods and procedures to be applied:	Adjusted by multiplying 0.844 kg/l (density of diesel) to the NCV value in TJ/Gg (43.0 TJ/Gg) provided for Gas/Diesel in the IPCC guideline.
Monitoring frequency	Annually
QA/QC procedures to be applied:	From IPCC default value, QA/QC procedures are not applicable.
Any comment:	

Data / Parameter:	EF_{fuel}
Data unit:	tCO_2 / MJ
Description:	Emission factor of the fuel
Source of data to be used:	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.000074
Description of measurement methods and procedures to be applied:	
Monitoring frequency	Annually
QA/QC procedures to	As per the methodology, since local value for the CO2 emission factor is not

be applied:	available, IPCC default value will be used.
Any comment:	

Data / Parameter:	$M_{compost,y}$
Data unit:	tonnes / yr
Description:	Quantity of compost produced.
Source of data to be used:	Record of compost facility
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Year: $M_{compost,y}$ (tonnes/yr) 2013: 5,095 2014: 5,095 2015: 5,095 2016: 5,095 2017: 5,095 2018: 5,095 2019: 5,095 2020: 5,095 2021: 5,095 2022: 5,095
Description of measurement methods and procedures to be applied:	Measured by truck scale. Data will be stored by paper as well as electronic data.
Monitoring frequency	Annually
QA/QC procedures to be applied:	Periodical calibration of the truck scale.
Any comment:	

Year	$M_{compost,y}$
	tonnes/yr
2013	5,095
2014	5,095
2015	5,095
2016	5,095
2017	5,095
2018	5,095
2019	5,095
2020	5,095
2021	5,095
2022	5,095

Data / Parameter:	$S_{a,y}$
Data unit:	%
Description:	Share of the waste that degrades under anaerobic conditions (i.e., samples with oxygen content below 10%) in the composting plant during year y
Source of data to be used:	On-site measurement with oxygen sensor
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0 (For ex-ante estimation, it is assumed that no samples will have oxygen deficiency in the composting process.)
Description of measurement methods and procedures to be applied:	$S_{a,y}$ is the number of samples per year with oxygen deficiency ($S_{OD,y}$)divided by total number of samples ($S_{total,y}$) taken per year. The oxygen content is measured by calibrated oxygen sensor. The total number of samples should ensure 20% uncertainty at 95% confidence level. To achieve this minimum 25 number of samples will be taken weekly. The results are aggregated monthly and then

	accumulated annually.
Monitoring frequency	Weekly
QA/QC procedures to be applied:	O_2-measurement-instrument will be subject to periodic calibration (in accordance with stipulation of instrument-supplier). Measurement itself to be done by using a standardised mobile gas detection instrument. A statistically significant sampling procedure will be set up that consists of multiple measurements throughout the different stages of the composting process according to a predetermined pattern (depths and scatter) on a weekly basis.
Any comment:	

Data / Parameter:	$S_{OD,y}$
Data unit:	Dimensionless
Description:	The number of samples taken per year with an oxygen deficiency (i.e. oxygen content below 10%)
Source of data to be used:	On-site measurement with oxygen sensor
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0 (For ex-ante estimation, it is assumed that no samples will have oxygen deficiency in the composting process.)
Description of measurement methods and procedures to be applied:	Oxygen concentration will be measured using a portable oxygen analyzer.
Monitoring frequency	Weekly
QA/QC procedures to be applied:	O_2-measurement-instrument will be subject to periodic calibration (in accordance with stipulation of instrument-supplier). Measurement itself to be done by using a standardised mobile gas detection instrument. A statistically significant sampling procedure will be set up that consists of multiple measurements throughout the different stages of the composting process according to a predetermined pattern (depths and scatter) on a weekly basis.
Any comment:	

Data / Parameter:	$S_{total,y}$
Data unit:	Dimensionless
Description:	The total number of samples taken per year.
Source of data to be used:	On-site measurement with oxygen sensor
Value of data applied for the purpose of calculating expected emission reductions in section B.5	number of samples taken will be decided after commencement of the project taking into account the result of the first measurement

Description of measurement methods and procedures to be applied:	The oxygen content is measured by calibrated oxygen sensor. The total number of samples will be measured. The data are aggregated monthly but accumulated once per year.
Monitoring frequency	Weekly
QA/QC procedures to be applied:	Frequency of measurement and the number of samples taken will be decided so as to comply with the statistical requirements.
Any comment:	

Data / Parameter:	W_x
Data unit:	Tonnes/year
Description:	Total amount of organic waste prevented from disposal during the year x
Source of data to be used:	On-site measurements
Value of data applied for the purpose of calculating expected emission reductions in section B.5	see table below
Description of measurement methods and procedures to be applied:	The amount of organic waste prevented from disposal is the amount of organic waste processed at the composting facility. This amount will be measured at the truck scale which will be located at the entrance of the facility.
Monitoring frequency	Continuous
QA/QC procedures to be applied:	Periodical calibration of the truck scale.
Any comment:	

Year	W_x
	tons/yr
2013	18,250
2014	18,250
2015	18,250
2016	18,250
2017	18,250
2018	18,250
2019	18,250
2020	18,250
2021	18,250
2022	18,250

Data / Parameter:	$P_{n,j,x}$
Data unit:	% by weight of waste
Description:	Weight fraction of the waste type j in the sample n collected during the year x
Source of data to be used:	Sample on-site measurements

<table>
<tr><td>Value of data applied for the purpose of calculating expected emission reductions in section B.5</td><td>
<table>
<tr><td rowspan="2">Waste Type</td><td>$P_{n,j,x}$</td></tr>
<tr><td>%</td></tr>
<tr><td>Food</td><td>36</td></tr>
<tr><td>Garden</td><td>8</td></tr>
<tr><td>Paper</td><td>14</td></tr>
<tr><td>Wood and Straw</td><td>6</td></tr>
<tr><td>Textile</td><td>3</td></tr>
<tr><td>Plastics, other inert</td><td>32</td></tr>
</table>
</td></tr>
<tr><td>Description of measurement methods and procedures to be applied:</td><td>Volume of waste to be sampled, and the frequency of sampling will be adjusted in the project activity to meet the statistical requirements.</td></tr>
<tr><td>Monitoring frequency</td><td>The size and frequency of sampling should be statistically significant with a maximum uncertainty range of 20% at a 95% confidence level. Sampling will be undertaken at least four times per year.</td></tr>
<tr><td>QA/QC procedures to be applied:</td><td></td></tr>
<tr><td>Any comment:</td><td></td></tr>
</table>

Data / Parameter:	z
Data unit:	-
Description:	Number of samples taken per year, for determination of waste composition, $P_{n,j,x}$
Source of data to be used:	On-site measurement
Value of data applied for the purpose of calculating expected emission reductions in section B.5	N/A
Description of measurement methods and procedures to be applied:	Number of samples taken for analysis will be recorded on paper and electronic format.
Monitoring frequency	Continuous
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	$A_{Ci,x}$
Data unit:	tonnes/yr
Description:	Amount of residual waste type ‘ci’ from anaerobic digestion, gasifier or processing /combustion of RDF and stabilized biomass
Source of data to be used:	Plant records

<table>
<tr><td>Value of data applied for the purpose of calculating expected emission reductions in section B.5</td><td>
<table>
<tr><td rowspan="2">Waste Type</td><td>$A_{ci,x}$</td></tr>
<tr><td>tons/yr</td></tr>
<tr><td>Food</td><td>2,622</td></tr>
<tr><td>Garden</td><td>599</td></tr>
<tr><td>Paper</td><td>1,132</td></tr>
<tr><td>Wood and Straw</td><td>444</td></tr>
<tr><td>Textile</td><td>225</td></tr>
<tr><td>Plastics, other inert</td><td>73</td></tr>
<tr><td>Total</td><td>5.095</td></tr>
</table>
</td></tr>
<tr><td>Description of measurement methods and procedures to be applied:</td><td>Weighbridge</td></tr>
<tr><td>Monitoring frequency</td><td>Annually</td></tr>
<tr><td>QA/QC procedures to be applied:</td><td></td></tr>
<tr><td>Any comment:</td><td></td></tr>
</table>

Data / Parameter:	***f_C***
Data unit:	%
Description:	Fraction of waste diverted, from the landfill to all project activity (composting)
Source of data to be used:	Plant records
Value of data applied for the purpose of calculating expected emission reductions in section B.5	100: All the collected organic wastes are diverted to aerobic treatment.
Description of measurement methods and procedures to be applied:	Weigh bridge
Monitoring frequency	Monthly
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	***GWP_{N2O}***
Data unit:	-
Description:	Global Warming Potential of nitrous oxide
Source of data to be used:	Decisions under UNFCCC and the Kyoto Protocol
Value of data applied for the purpose of calculating expected	310

emission reductions in section B.5	
Description of measurement methods and procedures to be applied:	Decisions under UNFCCC and the Kyoto Protocol (a value of 310 is to be applied for the first commitment period of the Kyoto Protocol)
Monitoring frequency	Annually
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	GWP_{CH4}
Data unit:	tCO_2e/tCH_4
Description:	Global Warming Potential (GWP) of methane, valid for the relevant commitment period
Source of data to be used:	Decisions under UNFCCC and the Kyoto Protocol
Value of data applied for the purpose of calculating expected emission reductions in section B.5	21
Description of measurement methods and procedures to be applied:	Decisions under UNFCCC and the Kyoto Protocol (a value of 21 is to be applied for the first commitment period of the Kyoto Protocol)
Monitoring frequency	Annually
QA/QC procedures to be applied:	
Any comment:	

B.7.2. Description of the monitoring plan:

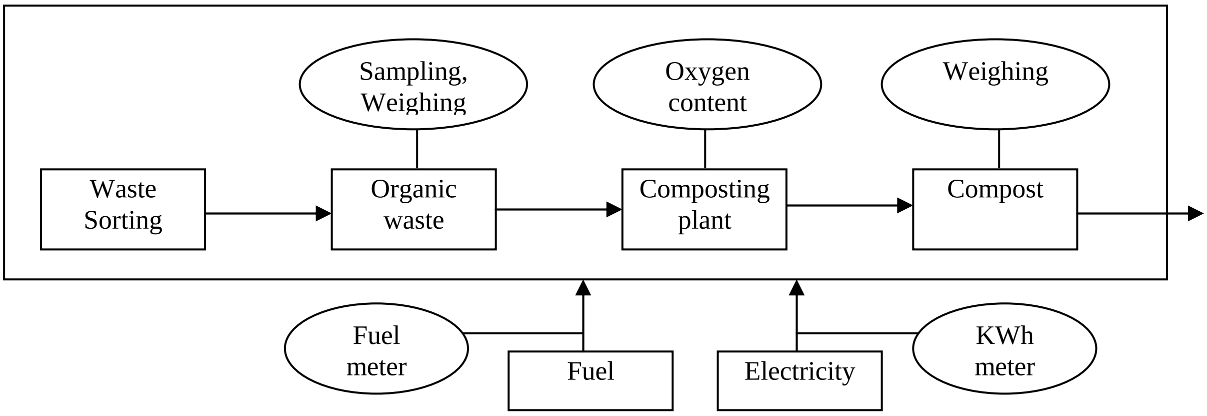
This project adopts the approved monitoring methodology AM0025 version 12 “Avoided emissions from organic waste through alternative waste treatment process”.

The monitoring plan defines the standards and rules according to which the emission reductions and any leakage effects of the project activity are monitored and verified in conformance with all relevant requirements of the CDM. The monitoring plan includes the responsibilities for and institutional arrangement for data collection and archiving. The monitoring plan and procedures can be updated and adjusted to meet the operational requirements and verified each year by the verifying organisation (DOE).

1. Purpose

The monitoring plan is designated to monitor the parameters listed in B.7.1, which are required for calculation of the actual GHG emission reduction achieved by the Project.

The following figure shows the parameters that should be monitored:



2. Management structure of the monitoring plan

The project owner will form an operational and management team, which will be responsible for monitoring of all the aforementioned parameters. This team will be composed of a general manager and a group of operators. The group of operators, under the supervision of the general manager, will be assigned for monitoring of the parameters on a timely basis and will perform the recording and archiving of data in an orderly manner. Monitoring reports will be forwarded to and reviewed by the general manager on a monthly basis in order to ensure the project follows the requirements of the monitoring plan.

3. Training of monitoring personnel

General manager should provide operators with enough professional training, evaluate and record the validity of training.

4. Measurement Procedure

(1) Measurement equipments

KWh meter

Working condition	Voltage range: , temperature:
Function	Data collection and transport
Accuracy grade	1
Calibration	by credible organization to be appointed
Calibration frequency	Once a year

Oxygen sensor

Working condition	Oxygen content:0.1~25Vol% with ±2%MBE,
Temperature range	0℃～100℃

Function	Computer controlled on-line measurement
Calibration	by credible organization to be appointed
Calibration frequency	Once a year

Weighbridge

Working condition	10~30000kg
Maximum loading	125%FS
Accuracy	±0.3%
Function	Weighing, data screening, recording and printing
Calibration	by credible organization to be appointed
Calibration frequency	Once a year

The quantity of fuel consumption on-site during year y of the crediting period ($F_{cons, y}$) should also be monitored, as the project needs to use diesel oil for vehicles and machineries on site. The consumption will be measured by recording the reading oilcan. The data will be crosschecked with the purchase invoice of the diesel oil.

(3) Data collection

This monitoring plan includes MSW composition analysis, MSW properties analysis, and measuring of the quantity of MSW and electricity. Additionally, monitoring of laws and regulations, as well as compliance is included in this monitoring plan. The data to be collected is listed below:

- The MSW composition analysis, waste type by weight, and analysis of MSW properties.
- Oxygen content of the organic waste being aerobically treated
- Electricity consumption on the project site
- Annual diesel oil consumption on the project site
- The time and date each monitoring period starts and ends.

(3) Measurement method

See tables in chapter B7.1

(4) Monitoring report

A monitoring report in line with CDM regulations and the requirements of this monitoring methodology will be issued annually by the general manager.

The monitoring report will contain a summary of the whole monitoring plan, and will describe the implementation of the monitoring plan in that particular year, present the relevant results and data, and calculate emission reductions for the period.

(5) Calibration

Regular calibration will be necessary for the monitoring equipment. The necessary calibration will be performed according to the manufacturer's guidelines, or according to the applicable regulations, by a suitably skilled technician at the required frequency (at least once a year). A certificate of calibration will be provided for each piece of equipment after completion. The calibration records will be archived by the project owner for the DOE verification.

(6) Data management

All data collected as part of monitoring plan should be archived electronically and be kept for at least 2 years after the end of the crediting period.

B.8. Date of completion of the application of the baseline study and monitoring methodology and the name of the responsible person(s)/entity(ies):

Kaoru Nakajima
Yachiyo Engineering Co., Ltd.
2-18-12 Nishiochiai
Shinjuku-ku
Tokyo Japan
Telephone: +81-3-5906-0212
E-mail: ko-nakajima@yachiyo-eng.co.jp

Katsuyoshi Takahashi
Technomodesty Co., Ltd.
866-6 Yokura
Katori City
Chiba Japan
Telephone: +81-478-58-1347
E-mail: technomodesty@yahoo.com

SECTION C. Duration of the project activity / crediting period

C.1. Duration of the project activity:

C.1.1. Starting date of the project activity:

The project is expected to start from January 2013 (1/1/2013).

C.1.2. Expected operational lifetime of the project activity:

10 years.

C.2. Choice of the crediting period and related information:

C.2.1. Renewable crediting period:

C.2.1.1. Starting date of the first crediting period:

NA

C.2.1.2. Length of the first crediting period:

NA

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

January 2013 or the date of registration, whichever is later

C.2.2.2. Length:

10 years

SECTION D. Environmental impacts

D.1. Documentation on the analysis of the environmental impacts, including transboundary impacts:

>>
In Malaysia, Environmental Impact Assessment (EIA) is required for the activities prescribed under the Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order 1987.

Construction of composting facility, which appears to be similar to the proposed project activity of aerobic treatment of organic waste, is a prescribed activity in this document. However, it was learned at the meeting with Department of Environment, Ministry of Natural Resources and Environment that the EIA requirement may be waived for pilot facilities with small scale installed inside landfills. The letter was already sent to the Directorate General, Ministry of Natural Resources and Environment to confirm the EIA exemption.

Nevertheless, according to the Guideline for Siting and Zoning of Industry issued by Department of Environment, the project proponent should submit a preliminary screening form for the establishment of new facility (PAT) describing the project components and specification of the facilities to Department of Environment. The project proponent shall submit the screening form for approval.

The project might have some environmental impacts such as air pollution, noise and vibration, etc. which may occur along with construction and operation of the facility. However, the project's overall impact on environment will be small, and be reduced to minimum by implementation of project.

Negative impacts that may occur on environment during construction and operation include as follows;

<Construction>

- Air pollution, through the use of fossil fuel on vehicles required for transportation of construction materials, and machinery required for construction.
- Generation of noise and vibration to some extent, due to material transportation, installation of the facilities, etc.
- Generation of the waste due to the construction work

<Operation>

- Generation of noise and vibration due to the facility operation
- Generation of odd smells, due to the storage and treatment of organic wastes.

These negative impacts shall be reduced by taking the appropriate mitigation measures. In addition, all the potential negative impacts were taken into account in the environmental management plan which was developed in accordance with the Environmental Impact Assessment System defined by the Law on Environmental Protection.

Positive environmental impacts of the project activity are as follows;

- Significant decrease in methane generation due to organic waste degradation in the landfill, which contributes to the GHG emissions reduction
- Decrease in leachate generation and its contaminant load in the landfill.
- Extension of the landfill life time due to smaller amount of disposed waste
- Improvement of landfill's stability
- Mitigation of fire / explosions risk in the landfill caused by methane gas emissions from disposed organic wastes
- Recovery of recycling materials and saving of new raw materials

D.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

There are no significant negative environmental impacts resulting from the project activity.

SECTION E. Stakeholders' comments

>>

E.1. Brief description how comments by local stakeholders have been invited and compiled:

This project is to establish the waste treatment facilities within on the area of the existing landfill site.

Thus, the local stakeholders in the project area include;

1. Ministry of Natural Resources and Environment (NRE) – NRE is the DNA in Malaysia.
2. Perak State Government – The project site is located in Perak State.
3. Ipoh City Council– The project site is located in Ipoh City, Perak State.
4. LEE TUCK CONSTRUCTION SDN.BHD. (LT) – LT is the local counterpart company in Malaysia in this project and in charge of collection of MSW and management of the existing landfill.
5. Neighborhood inhabitants – There are no immediate inhabitants, but there are some living comparatively close.

The project participants have heard comments from NRE, Perak State, Ipoh City, LT, and Neighborhood inhabitants. At that time, the general plans on project activities including applied methodologies, project scale, implementation structures, schedule, etc. were also explained.

E.2. Summary of the comments received:

Since this project will contribute to improving the waste management in Ipoh City, as well as reducing the GHG emission through the organic waste composting, all the stakeholders welcomed the project activities and expressed their support for the implementation of project in Ipoh City.

Major comments from stakeholders are as follows;

1. Ministry of Natural Resources and Environment (NRE) – There are some CDM projects in Malaysia, but not so much in the “Waste handling and disposal” category. The most popular category is concerning “Biomass”. As they positively accept technical support through CDM project in Malaysia, it would be fine to get technical support also in this project.
2. Perak State – The presentation about CDM project (for Ipoh City) was taken place in Ipoh City office on August, 2009. The officer expects that this project will be carried on in close cooperation with Ipoh City.
3. Ipoh City – The presentation about CDM project (for Ipoh City) was taken place in Ipoh City office on August, 2009. The mayor showed a favorable understanding of this project, on the other hand, he suggested there is a rival on this matter.
4. LT – LT wants the technical support for waste management as well as this project.
5. Neighborhood inhabitants – At the moment, they don’t have big problems except odor one. After explained the outline of this project, many inhabitants want to positively go ahead with it because it will make the environment better.

E.3. Report on how due account was taken of any comments received:

At present, the project has not received any claims from local stakeholders to obstruct its implementation.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	LTC ALAM BERSIH S/B
Street/P.O.Box:	129-B, JALAN KAMPAR
Building:	
City:	30250 IPOH
State/Region:	PERAK
Postcode/ZIP:	
Country:	MALAYSIA
Telephone:	+605-2547129
FAX:	+605-2417334
E-Mail:	leetuck@pd.jaring.my
URL:	
Represented by:	LEE TUCK
Title:	president
Salutation:	Mr.
Last name:	LEE
Middle name:	
First name:	TUCK
Department:	
Mobile:	
Direct FAX:	+805-2417334
Direct tel:	+805-2547129
Personal e-mail:	

Organization:	
Street/P.O.Box:	
Building:	
City:	
State/Region:	
Postcode/ZIP:	
Country:	
Telephone:	
FAX:	
E-Mail:	
URL:	
Represented by:	
Title:	
Salutation:	
Last name:	
Middle name:	
First name:	
Department:	

Mobile:	
Direct FAX:	
Direct tel:	
Personal e-mail:	

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

The project will not involve any public funding or Official Development Assistance (ODA).

Annex 3

BASELINE INFORMATION

1. Waste composition analysis

(1) Composition of incoming waste

Composition of incoming waste in the plant used in baseline emission estimation was determined based on the result of waste composition analysis conducted by Midac Co., Ltd. in 2009. The results and outline of the composition analysis are as described below;

Table 3-1: Basic condition on the analysis

Date	23/11/2009 ~ 27/11/2009
Place	Existing landfill in Ipoh City
Objective	1. Understanding the waste composition installed to the landfill 2. Understanding the recyclables
Volume of waste	50 tons/day
Origin of waste	The waste is originated from Household, Shop, and Market, the ratio of each item is 70%, 25%, and 5%.

Table 3-2: Average composition of the incoming waste in the plant

Waste Type	Tons/day	%
Food	18	36
Garden	4	8
Wood and Straw	3	6
Paper	7	14
Textile	1.5	3
Others	16	32
Plastics	8.1	16.2
Glass	0.9	1.8
Steel	0.95	1.9
Aluminium	0.05	0.1
Nappies	5.45	10.9
Other inert	0.7	1.4

(2) Composition of wastes before/after composting

Based on the survey results, composition of compost waste used in calculation of leakage emission is determined as shown in the table below. (Only includes organic wastes because recyclables have been taken out by sorting) as follows:

Table 3-3: Composition of wastes before/after composting

	Before Composting		After composting	
	Ton/day	%	Ton/day	%
Food	18	53%	7.2	51%
Garden	4	12%	1.6	12%
Wood and Straw	3	9%	1.2	9%
Paper	7	21%	3.1	22%
Textile	1.5	4%	0.6	4%
Others	0.2	1%	0.2	2%

2. Calculation of Emission Factor

The electricity consumed on-site is purchased from the TNB national grid of Peninsula Malaysia. The emission factor of the grid is calculated according to “Tool to calculate the emission factor for an electricity system (Version02)”. The latest available baseline electricity data was obtained from the Final Report for the Study on Grid Connected Electricity Baselines in Malaysia (Year 2006 - 2007) published by the Malaysia Energy Centre (PTM) in December 2008.

In accordance to the above mentioned tool, the following six steps were applied:

Step 1: Identify the relevant electric power system

There are 3 electricity grid system in Malaysia, namely, the Peninsula Malaysia national grid operated by the Tenaga Negara Berhad, the Sarawak State grid operated by Sarawak Energy Corporation and Sabah State grid operated by Sabah Electricity Supply Berhad (SESB). The electricity supply to the Ipoh City is imported from the national grid of Peninsular Malaysia.

Step 2: Choose whether to include off-grid power plants in the project electricity system (optional)

Option 1, “only grid power plants are included in the calculation” was chosen for this project.

Step 3: Select an operating margin (OM) method

Since the low-cost/must-run resources constitute less than 50% of total grid generation on average of the five most recent years, the calculation of the operating margin emission factor ($EF_{grid,OM,y}$) is based on “Simple OM” method.

Step 4: Calculate the operating margin emission factor according to the selected method

The simple OM emission factor is calculated as the generation-weighted average CO_2 emissions per unit net electricity generation (tCO2/MWh) of all generating power plants serving the system in Peninsula Malaysia, not including low-cost / must-run power plants/ units.

The Simple OM is calculated based on the net electricity generation and a CO_2 emission factor of each power unit (Option A), using the following formula.

$$EF_{grid,OMsimple,y} = \frac{\sum_{m} EG_{m,y} \cdot EF_{EL,m,y}}{\sum_{m} EG_{m,y}}$$

Where:

$EF_{grid,OM,y}$:Simple operating margin CO_2 emission factor in year y (tCO_2/MWh)

$EG_{m,y}$: Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)

$FE_{EL,m,y}$: CO_2 emission factor of power unit m in year y (tCO_2/MWh)

m : All power units serving the grid in year y except low-cost /must-run power units

y : Either the three most recent years for which data is available at the time of submission of the CDM-PDD to the DOE for validation (ex-ante option)

The Simple OM is calculated using the data of all operation fossil fuel fired power plants generating electricity to the grid for the years 2005, 2006 and 2005.

Simple Operating Margin for Peninsular Malaysia for 2007

Years	Generation (GWh)	CO_2 Emission (tonnes)	Baselines (tCO2/MWh)
2007	89,241	56,409,586	0.632
2006	85,421	51,809,152	0.607
2005	82,605	49,150,332	0.595
Average Operating Margin for 3 years			**0.611**

Step 5: Identify the group of power units to be included in the build margin (BM)

The sample group of power units "m" used to calculate the build margin consists of the set of (a) five power units that have been built most recently. The source of data is from Energy Commission of Malaysia, as shown in the table below.

The total output generated by these 5 plants in 2007 is 33,206,840 MWh, resulting in 35% (i.e. more than 20% as stipulated by the "Tool to calculate the emission factor for an electricity system") of the total system generation in Peninsular Malaysia (90,950,000 MWh).

Name of Power Plants/ Fuel Types	**Year of Operation**	**Type**	**Capacity (MW)**	**Total Generation (MWh)**	**CO2 Emission (tCO2)**
1. SKS Prai Power Station	2002	Gas & Distillate	350	2,483,310	1,049,809
2. Panglima Power Station	2003	Gas & Distillate	720	5,419,930	2,186,230
3. Janamanjung Power Station	2003	Coal	2070	11,248,290	11,363,743
4. Tuanku Jaafar Power Station	2005	Gas & Distillate	714	5,759,730	2,361,373
5. Tanjung Bin Power Station	2006/2007	Coal	1400	8,295,580	8,184,319
Total				**33,206,840**	**25,145,474**

In terms of vintage of data, Option 1 is chosen, in which, for the first credit period, the build margin emission factor ex-ante is calculated based on the most recent information available on units already built for sample group m at the time of CDM-PDD submission to the DOE for validation. For the second crediting period, the build margin emission factor should be updated based on the most recent information available on units already built at the time of submission of the request for renewal of the crediting period to the DOE. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used. This option does not require monitoring the emission factor during the crediting period.

Step 6: Calculate the build margin emission factor

The build margin emissions factor is the generation-weighted average emission factor (tCO2/MWh) of all power units *m* during the most recent year y for which power generation data is available, calculated as follows:

$$EF_{grid,BM,y} = \frac{\sum_{m} EG_{m,y} \times EF_{EL,m,y}}{\sum_{m} EG_{m,y}}$$

Where:

$EF_{grid,OM,y}$:Build margin CO_2 emission factor in year y(tCO_2/MWh)

$EG_{m,y}$: Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)

$FE_{EL,m,y}$: CO_2 emission factor of power unit m in year y (tCO_2/MWh)

m : Power units included in the build margin

y : Most recent historical year for which power generation data is available

The total CO2 emission from the 5 power plants is calculated to be 25,145,474 tons CO2. Therefore the Build Margin for Peninsular Malaysia is calculated as follows;

$EF_{grid,OM,y}$ = 25,145,474 tonne CO2 / 33,206,840 MWh = **0.757 tonnes of CO2/MWh**

Step 7: Calculate the combined margin emissions factor

The combined margin emissions factor is calculated as follows:

$EF_{grid,CM,y} = EF_{grid,OM,y} \cdot w_{OM} + EF_{grid,BM,y} \cdot w_{BM}$

Where:

$EF_{grid,OM,y}$:Build margin CO_2 emission factor in year y(tCO_2/MWh)
$EF_{grid,OM,y}$:Simple operating margin CO_2 emission factor in year y (tCO_2/MWh)
w_{OM} :Weighting of operating margin emissions factor (%)
w_{BM} :Weighting of build margin emissions factor (%)

The recommended values applied for w_{OM} and w_{BM} is both at 0.5 for the first crediting period.

Thus, the calculations are as below:

$EF_{grid,CM,y}$ = 0.611 * 0.5 + 0.757 * 0.5 = **0.684 tCO_2/MWh**

3. Emission Reduction Calculation

(1) Baseline Emission Calculation

Parameters

Parameters	Units	Values
Landfill Operational parameters		
Landfill Starting Year / Composting Starting Year	Year	2013
Landfill Closing Year / Composting Closing Year	Year	2032
Daily Waste Disposal Rate /Daily Waste Processed in Compost Plant	Tons/day	50
No. of Operating days in a year	days	365
Waste Composition		
Pulp, paper, Cardboard (other than Sludge)	% of Wet MSW	14.0%
Textiles	% of Wet MSW	3.0%
Food and Food Waste, beverages and tobacco (other than sludge)	% of Wet MSW	36.0%
Garden,Yard and Park Waste	% of Wet MSW	8.0%
Wood & Wood Products	% of Wet MSW	6.0%
Waste Degradability (DOC-j)		
Pulp, paper, Cardboard (other than Sludge)	% of Wet MSW Fraction	40%
Textiles	% of Wet MSW Fraction	24%
Food and Food Waste, beverages and tobacco (other than sludge)	% of Wet MSW Fraction	15%
Garden,Yard and Park Waste	% of Wet MSW Fraction	20%
Wood & Wood Products	% of Wet MSW Fraction	43%
Waste Decay Rates (K-j)		
Pulp, paper, Cardboard (other than Sludge)	per year	0.07
Textiles	per year	0.07
Food and Food Waste, beverages and tobacco (other than sludge)	per year	0.4
Garden,Yard and Park Waste	per year	0.17
Wood & Wood Products	per year	0.035
Fraction of DOC that actually degrades (DOC-f)		
Fraction of DOC that can decompose in a landfill	Fraction	**0.5**
Methane Correction Factor (MCF)		
Managed landfill	Fraction	1
Unmanaged (> 5 M deep)	Fraction	0.8
Unmanaged (< 5 M deep)	Fraction	0.4
Semi-aerobic managed	Fraction	0.5
MCF used for calculation of CH4 emissions		**1.0**
Landfill Gas Characteristics (F)		
Fraction of methane in Landfill gas	Fraction	**0.5**
Density of Methane (1.013 bar and 15 °C (59 °F))	kg/m3	0.7168
Global warming potential of Methane	Number	21

Oxidation Factor (OX)		
Oxidation Factor (OX)	Fraction	**0.1**
Model Accuracy		
Model Correction Factor (Phi)	Fraction	**0.9**
LFG Capture in the baseline		
Fraction of methane Captured at the SWDS and flared/combusted	Fraction	**0**

Methane Generation Profile

Year	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Total	
											tCH4	tCO2
2013	125	0	0	0	0	0	0	0	0	0	**125**	**2635**
2014	93	125	0	0	0	0	0	0	0	0	**219**	**4589**
2015	71	93	125	0	0	0	0	0	0	0	**289**	**6071**
2016	55	71	93	125	0	0	0	0	0	0	**344**	**7222**
2017	44	55	71	93	125	0	0	0	0	0	**388**	**8139**
2018	36	44	55	71	93	125	0	0	0	0	**423**	**8888**
2019	30	36	44	55	71	93	125	0	0	0	**453**	**9513**
2020	25	30	36	44	55	71	93	125	0	0	**478**	**10047**
2021	22	25	30	36	44	55	71	93	125	0	**500**	**10510**
2022	19	22	25	30	36	44	55	71	93	125	**520**	**10919**

(2) Leakage Emission (Leakage from compost products disposed of in the landfill)

Parameters

Waste Composition		
Pulp, paper, Cardboard (other than Sludge)	% of Wet MSW	22.0%
Textiles	% of Wet MSW	4.0%
Food and Food Waste, beverages and tobacco (other than sludge)	% of Wet MSW	51.0%
Garden,Yard and Park Waste	% of Wet MSW	12.0%
Wood & Wood Products	% of Wet MSW	9.0%

*Other parameters are same as that used in baseline emission calculation.

Methane Generation Profile

Year	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Total	
											tCH4	tCO2
2013	51	0	0	0	0	0	0	0	0	0	**51**	**1069**
2014	38	51	0	0	0	0	0	0	0	0	**89**	**1866**
2015	29	38	51	0	0	0	0	0	0	0	**118**	**2474**
2016	23	29	38	51	0	0	0	0	0	0	**140**	**2949**
2017	18	23	29	38	51	0	0	0	0	0	**159**	**3330**
2018	15	18	23	29	38	51	0	0	0	0	**173**	**3642**
2019	12	15	18	23	29	38	51	0	0	0	**186**	**3905**
2020	11	12	15	18	23	29	38	51	0	0	**197**	**4129**
2021	9	11	12	15	18	23	29	38	51	0	**206**	**4325**
2022	8	9	11	12	15	18	23	29	38	51	**214**	**4499**

(3) Emission Reduction

Year	PE (tCO2)	BE (tCO2)	Leakage (tCO2)	Emission Reduction (tCo2)
2013	189	2,635	1,069	1,377
2014	189	4,589	1,866	2,534
2015	189	6,071	2,474	3,408
2016	189	7,222	2,949	4,084
2017	189	8,139	3,330	4,620
2018	189	8,888	3,642	5,057
2019	189	9,513	3,905	5,420
2020	189	10,047	4,129	5,728
2021	189	10,510	4,325	5,996
2022	189	10,919	4,499	6,231
2023	189	11,285	4,654	6,441
2024	189	11,614	4,795	6,630
2025	189	11,914	4,923	6,802
2026	189	12,189	5,040	6,960
2027	189	12,442	5,148	7,104
2028	189	12,676	5,248	7,238
2029	189	12,893	5,341	7,362
2030	189	13,094	5,427	7,478
2031	189	13,282	5,508	7,585
2032	189	13,457	5,583	7,685

4. IRR Spread Sheet

IRR for basic scenario (20 years)

Total Project Cost	-4,368,650	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Maintenance & Repair cost		91,843	93,405	94,992	96,607	98,250	99,920	101,619	103,346	105,103	106,890
Electricity cost		8,634	8,781	8,930	9,082	9,236	9,393	9,553	9,715	9,881	10,049
Fuel (Diesel) cost		72,000	73,224	74,469	75,735	77,022	78,332	79,663	81,018	82,395	83,796
Labour cost		476,400	495,932	516,266	537,433	559,467	582,405	606,284	631,142	657,018	683,956
Total Expenses (RM/year)		**648,877**	**671,342**	**694,657**	**718,857**	**743,975**	**770,050**	**797,119**	**825,221**	**854,397**	**884,690**
Revenue from CER		0	0	0	0	0	0	0	0	0	0
Revenue from Recyclables Sales (MYR)		309,520	314,782	320,133	325,575	331,110	336,739	342,464	348,285	354,206	360,228
Revenue from Cover Soil displacement		152,850	155,448	158,091	160,779	163,512	166,292	169,119	171,994	174,917	177,891
Total revenue from project activities (RM/year)		**462,370**	**470,230**	**478,224**	**486,354**	**494,622**	**503,031**	**511,582**	**520,279**	**529,124**	**538,119**
Depreciation		436,865	436,865	436,865	436,865	436,865	436,865	436,865	436,865	436,865	436,865
EBIT (Revenue - Expenses-Depreciation)		-623,372	-637,977	-653,298	-669,368	-686,218	-703,885	-722,402	-741,807	-762,138	-783,436
Loss carried forward		-623,372	-1,261,349	-1,914,647	-2,584,014	-3,270,233	-3,974,117	-4,696,519	-5,438,326	-6,200,464	-6,983,900
Income TAX	25%	0	0	0	0	0	0	0	0	0	0
Nett Income (EBIT - income tax)		-623,372	-637,977	-653,298	-669,368	-686,218	-703,885	-722,402	-741,807	-762,138	-783,436
Free Cash Flow (Net Income + Depreciation)	-4,368,650	-186,507	-201,112	-216,433	-232,503	-249,353	-267,020	-285,537	-304,942	-325,273	-346,571
IRR (20 years) without CDM	**#NUM!**										

IRR for initial cost +10%

Total Project Cost	-4,805,515	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Maintenance & Repair cost		101,028	102,745	104,492	106,268	108,075	109,912	111,780	113,681	115,613	117,579
Electricity cost		8,634	8,781	8,930	9,082	9,236	9,393	9,553	9,715	9,881	10,049
Fuel (Diesel) cost		72,000	73,224	74,469	75,735	77,022	78,332	79,663	81,018	82,395	83,796
Labour cost		476,400	495,932	516,266	537,433	559,467	582,405	606,284	631,142	657,018	683,956
Total Expenses (RM/year)		**658,062**	**680,682**	**704,156**	**728,517**	**753,800**	**780,042**	**807,281**	**835,555**	**864,907**	**895,379**
Revenue from CER		0	0	0	0	0	0	0	0	0	0
Revenue from Recyclables Sales (MYR)		309,520	314,782	320,133	325,575	331,110	336,739	342,464	348,285	354,206	360,228
Revenue from Cover Soil displacement		152,850	155,448	158,091	160,779	163,512	166,292	169,119	171,994	174,917	177,891
Total revenue from project activities (RM/year)		**462,370**	**470,230**	**478,224**	**486,354**	**494,622**	**503,031**	**511,582**	**520,279**	**529,124**	**538,119**
Depreciation		480,552	480,552	480,552	480,552	480,552	480,552	480,552	480,552	480,552	480,552
EBIT (Revenue - Expenses-Depreciation)		-676,243	-691,003	-706,484	-722,715	-739,730	-757,563	-776,250	-795,828	-816,335	-837,812
Loss carried forward		-676,243	-1,367,247	-2,073,730	-2,796,445	-3,536,175	-4,293,738	-5,069,988	-5,865,816	-6,682,151	-7,519,962
Income TAX	25%	0	0	0	0	0	0	0	0	0	0
Nett Income (EBIT - income tax)		-676,243	-691,003	-706,484	-722,715	-739,730	-757,563	-776,250	-795,828	-816,335	-837,812
Free Cash Flow (Net Income + Depreciation)	-4,805,515	-195,692	-210,452	-225,932	-242,163	-259,178	-277,012	-295,699	-315,276	-335,783	-357,260
IRR (20 years) without CDM	**#NUM!**										

IRR for initial cost -10%

Total Project Cost	-3,931,785	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Maintenance & Repair cost		82,659	84,064	85,493	86,947	88,425	89,928	91,457	93,011	94,593	96,201
Electricity cost		8,634	8,781	8,930	9,082	9,236	9,393	9,553	9,715	9,881	10,049
Fuel (Diesel) cost		72,000	73,224	74,469	75,735	77,022	78,332	79,663	81,018	82,395	83,796
Labour cost		476,400	495,932	516,266	537,433	559,467	582,405	606,284	631,142	657,018	683,956
Total Expenses (RM/year)		**639,693**	**662,001**	**685,158**	**709,196**	**734,151**	**760,058**	**786,957**	**814,886**	**843,887**	**874,001**
Revenue from CER		0	0	0	0	0	0	0	0	0	0
Revenue from Recyclables Sales (MYR)		309,520	314,782	320,133	325,575	331,110	336,739	342,464	348,285	354,206	360,228
Revenue from Cover Soil displacement		152,850	155,448	158,091	160,779	163,512	166,292	169,119	171,994	174,917	177,891
Total revenue from project activities (RM/year)		**462,370**	**470,230**	**478,224**	**486,354**	**494,622**	**503,031**	**511,582**	**520,279**	**529,124**	**538,119**
Depreciation		393,179	393,179	393,179	393,179	393,179	393,179	393,179	393,179	393,179	393,179
EBIT (Revenue - Expenses-Depreciation)		-570,501	-584,950	-600,112	-616,020	-632,707	-650,206	-668,553	-687,786	-707,941	-729,061
Loss carried forward		-570,501	-1,155,451	-1,755,563	-2,371,583	-3,004,290	-3,654,496	-4,323,050	-5,010,835	-5,718,777	-6,447,837
Income TAX	25%	0	0	0	0	0	0	0	0	0	0
Nett Income (EBIT - income tax)		-570,501	-584,950	-600,112	-616,020	-632,707	-650,206	-668,553	-687,786	-707,941	-729,061
Free Cash Flow (Net Income + Depreciation)	-3,931,785	-177,323	-191,771	-206,934	-222,842	-239,528	-257,028	-275,375	-294,607	-314,763	-335,882
IRR (20 years) without CDM	**#NUM!**										

IRR for O&M cost +10% (excluding Labour cost)

Total Project Cost	-4,368,650	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Maintenance & Repair cost		101,028	102,745	104,492	106,268	108,075	109,912	111,780	113,681	115,613	117,579
Electricity cost		9,497	9,659	9,823	9,990	10,160	10,333	10,508	10,687	10,869	11,053
Fuel (Diesel) cost		79,200	80,546	81,916	83,308	84,724	86,165	87,630	89,119	90,634	92,175
Labour cost		476,400	495,932	516,266	537,433	559,467	582,405	606,284	631,142	657,018	683,956
Total Expenses (RM/year)		**666,125**	**688,883**	**712,496**	**736,999**	**762,426**	**788,815**	**816,202**	**844,629**	**874,135**	**904,763**
Revenue from CER		0	0	0	0	0	0	0	0	0	0
Revenue from Recyclables Sales (MYR)		309,520	314,782	320,133	325,575	331,110	336,739	342,464	348,285	354,206	360,228
Revenue from Cover Soil displacement		152,850	155,448	158,091	160,779	163,512	166,292	169,119	171,994	174,917	177,891
Total revenue from project activities (RM/year)		**462,370**	**470,230**	**478,224**	**486,354**	**494,622**	**503,031**	**511,582**	**520,279**	**529,124**	**538,119**
Depreciation		436,865	436,865	436,865	436,865	436,865	436,865	436,865	436,865	436,865	436,865
EBIT (Revenue - Expenses-Depreciation)		*-640,620*	*-655,517*	*-671,137*	*-687,510*	*-704,669*	*-722,649*	*-741,485*	*-761,215*	*-781,876*	*-803,510*
Loss carried forward		*-640,620*	*-1,296,137*	*-1,967,274*	*-2,654,784*	*-3,359,454*	*-4,082,103*	*-4,823,588*	*-5,584,802*	*-6,366,678*	*-7,170,188*
Income TAX	25%	0	0	0	0	0	0	0	0	0	0
Nett Income (EBIT - income tax)		-640,620	-655,517	-671,137	-687,510	-704,669	-722,649	-741,485	-761,215	-781,876	-803,510
Free Cash Flow (Net Income + Depreciation)	-4,368,650	-203,755	-218,652	-234,272	-250,645	-267,804	-285,784	-304,620	-324,350	-345,011	-366,645
IRR (20 years) without CDM	**#NUM!**										

IRR for O&M cost -10% (excluding Labour cost)

Total Project Cost	-4,368,650	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Maintenance & Repair cost		82,659	84,064	85,493	86,947	88,425	89,928	91,457	93,011	94,593	96,201
Electricity cost		7,771	7,903	8,037	8,174	8,313	8,454	8,598	8,744	8,893	9,044
Fuel (Diesel) cost		64,800	65,902	67,022	68,161	69,320	70,498	71,697	72,916	74,155	75,416
Labour cost		476,400	495,932	516,266	537,433	559,467	582,405	606,284	631,142	657,018	683,956
Total Expenses (RM/year)		**631,630**	**653,801**	**676,818**	**700,714**	**725,525**	**751,286**	**778,035**	**805,813**	**834,659**	**864,617**
Revenue from CER		0	0	0	0	0	0	0	0	0	0
Revenue from Recyclables Sales (MYR)		309,520	314,782	320,133	325,575	331,110	336,739	342,464	348,285	354,206	360,228
Revenue from Cover Soil displacement		152,850	155,448	158,091	160,779	163,512	166,292	169,119	171,994	174,917	177,891
Total revenue from project activities (RM/year)		**462,370**	**470,230**	**478,224**	**486,354**	**494,622**	**503,031**	**511,582**	**520,279**	**529,124**	**538,119**
Depreciation		436,865	436,865	436,865	436,865	436,865	436,865	436,865	436,865	436,865	436,865
EBIT (Revenue - Expenses-Depreciation)		*-606,125*	*-620,436*	*-635,459*	*-651,225*	*-667,768*	*-685,120*	*-703,318*	*-722,399*	*-742,400*	*-763,363*
Loss carried forward		*-606,125*	*-1,226,560*	*-1,862,019*	*-2,513,244*	*-3,181,012*	*-3,866,132*	*-4,569,450*	*-5,291,849*	*-6,034,249*	*-6,797,612*
Income TAX	25%	0	0	0	0	0	0	0	0	0	0
Nett Income (EBIT - income tax)		-606,125	-620,436	-635,459	-651,225	-667,768	-685,120	-703,318	-722,399	-742,400	-763,363
Free Cash Flow (Net Income + Depreciation)	-4,368,650	-169,260	-183,571	-198,594	-214,360	-230,903	-248,255	-266,453	-285,534	-305,535	-326,498
IRR (20 years) without CDM	**#NUM!**										

IRR for Labour cost + 10%

Total Project Cost	-4,368,650	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Maintenance & Repair cost		91,843	93,405	94,992	96,607	98,250	99,920	101,619	103,346	105,103	106,890
Electricity cost		8,634	8,781	8,930	9,082	9,236	9,393	9,553	9,715	9,881	10,049
Fuel (Diesel) cost		72,000	73,224	74,469	75,735	77,022	78,332	79,663	81,018	82,395	83,796
Labour cost		524,040	545,526	567,892	591,176	615,414	640,646	666,912	694,256	722,720	752,352
Total Expenses (RM/year)		**696,517**	**720,935**	**746,284**	**772,600**	**799,922**	**828,291**	**857,747**	**888,335**	**920,099**	**953,086**
Revenue from CER		0	0	0	0	0	0	0	0	0	0
Revenue from Recyclables Sales (MYR)		309,520	314,782	320,133	325,575	331,110	336,739	342,464	348,285	354,206	360,228
Revenue from Cover Soil displacement		152,850	155,448	158,091	160,779	163,512	166,292	169,119	171,994	174,917	177,891
Total revenue from project activities (RM/year)		**462,370**	**470,230**	**478,224**	**486,354**	**494,622**	**503,031**	**511,582**	**520,279**	**529,124**	**538,119**
Depreciation		436,865	436,865	436,865	436,865	436,865	436,865	436,865	436,865	436,865	436,865
EBIT (Revenue - Expenses-Depreciation)		*-671,012*	*-687,570*	*-704,924*	*-723,111*	*-742,165*	*-762,125*	*-783,030*	*-804,921*	*-827,840*	*-851,832*
Loss carried forward		*-671,012*	*-1,358,582*	*-2,063,506*	*-2,786,617*	*-3,528,782*	*-4,290,908*	*-5,073,938*	*-5,878,858*	*-6,706,698*	*-7,558,530*
Income TAX	25%	0	0	0	0	0	0	0	0	0	0
Nett Income (EBIT - income tax)		-671,012	-687,570	-704,924	-723,111	-742,165	-762,125	-783,030	-804,921	-827,840	-851,832
Free Cash Flow (Net Income + Depreciation)	-4,368,650	-234,147	-250,705	-268,059	-286,246	-305,300	-325,260	-346,165	-368,056	-390,975	-414,967
IRR (20 years) without CDM	**#NUM!**										

IRR for Labour cost -10%

Total Project Cost	-4,368,650	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Maintenance & Repair cost		91,843	93,405	94,992	96,607	98,250	99,920	101,619	103,346	105,103	106,890
Electricity cost		8,634	8,781	8,930	9,082	9,236	9,393	9,553	9,715	9,881	10,049
Fuel (Diesel) cost		72,000	73,224	74,469	75,735	77,022	78,332	79,663	81,018	82,395	83,796
Labour cost		428,760	446,339	464,639	483,689	503,521	524,165	545,656	568,028	591,317	615,561
Total Expenses (RM/year)		**601,237**	**621,749**	**643,030**	**665,113**	**688,029**	**711,810**	**736,490**	**762,107**	**788,695**	**816,294**
Revenue from CER		0	0	0	0	0	0	0	0	0	0
Revenue from Recyclables Sales (MYR)		309,520	314,782	320,133	325,575	331,110	336,739	342,464	348,285	354,206	360,228
Revenue from Cover Soil displacement		152,850	155,448	158,091	160,779	163,512	166,292	169,119	171,994	174,917	177,891
Total revenue from project activities (RM/year)		**462,370**	**470,230**	**478,224**	**486,354**	**494,622**	**503,031**	**511,582**	**520,279**	**529,124**	**538,119**
Depreciation		436,865	436,865	436,865	436,865	436,865	436,865	436,865	436,865	436,865	436,865
EBIT (Revenue - Expenses-Depreciation)		*-575,732*	*-588,383*	*-601,671*	*-615,624*	*-630,272*	*-645,644*	*-661,773*	*-678,692*	*-696,436*	*-715,041*
Loss carried forward		*-575,732*	*-1,164,116*	*-1,765,787*	*-2,381,411*	*-3,011,683*	*-3,657,327*	*-4,319,100*	*-4,997,793*	*-5,694,229*	*-6,409,269*
Income TAX	25%	0	0	0	0	0	0	0	0	0	0
Nett Income (EBIT - income tax)		-575,732	-588,383	-601,671	-615,624	-630,272	-645,644	-661,773	-678,692	-696,436	-715,041
Free Cash Flow (Net Income + Depreciation)	-4,368,650	-138,867	-151,518	-164,806	-178,759	-193,407	-208,779	-224,908	-241,827	-259,571	-278,176
IRR (20 years) without CDM	**#NUM!**										

IRR for revenue from recyclables sales + 10%

Total Project Cost	-4,368,650	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Maintenance & Repair cost		91,843	93,405	94,992	96,607	98,250	99,920	101,619	103,346	105,103	106,890
Electricity cost		8,634	8,781	8,930	9,082	9,236	9,393	9,553	9,715	9,881	10,049
Fuel (Diesel) cost		72,000	73,224	74,469	75,735	77,022	78,332	79,663	81,018	82,395	83,796
Labour cost		476,400	495,932	516,266	537,433	559,467	582,405	606,284	631,142	657,018	683,956
Total Expenses (RM/year)		**648,877**	**671,342**	**694,657**	**718,857**	**743,975**	**770,050**	**797,119**	**825,221**	**854,397**	**884,690**
Revenue from CER		0	0	0	0	0	0	0	0	0	0
Revenue from Recyclables Sales (MYR)		340,472	346,260	352,146	358,133	364,221	370,413	376,710	383,114	389,627	396,251
Revenue from Cover Soil displacement		152,850	155,448	158,091	160,779	163,512	166,292	169,119	171,994	174,917	177,891
Total revenue from project activities (RM/year)		**493,322**	**501,708**	**510,238**	**518,912**	**527,733**	**536,705**	**545,828**	**555,108**	**564,544**	**574,142**
Depreciation		436,865	436,865	436,865	436,865	436,865	436,865	436,865	436,865	436,865	436,865
EBIT (Revenue - Expenses-Depreciation)		*-592,420*	*-606,498*	*-621,284*	*-636,810*	*-653,107*	*-670,211*	*-688,155*	*-706,978*	*-726,717*	*-747,413*
Loss carried forward		*-592,420*	*-1,198,919*	*-1,820,203*	*-2,457,013*	*-3,110,120*	*-3,780,331*	*-4,468,487*	*-5,175,465*	*-5,902,182*	*-6,649,596*
Income TAX	25%	0	0	0	0	0	0	0	0	0	0
Nett Income (EBIT - income tax)		-592,420	-606,498	-621,284	-636,810	-653,107	-670,211	-688,155	-706,978	-726,717	-747,413
Free Cash Flow (Net Income + Depreciation)	-4,368,650	-155,555	-169,633	-184,419	-199,945	-216,242	-233,346	-251,290	-270,113	-289,852	-310,548
IRR (20 years) without CDM	**#NUM!**										

IRR for revenue from recyclables sales -10%

Total Project Cost	-4,368,650	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Maintenance & Repair cost		91,843	93,405	94,992	96,607	98,250	99,920	101,619	103,346	105,103	106,890
Electricity cost		8,634	8,781	8,930	9,082	9,236	9,393	9,553	9,715	9,881	10,049
Fuel (Diesel) cost		72,000	73,224	74,469	75,735	77,022	78,332	79,663	81,018	82,395	83,796
Labour cost		476,400	495,932	516,266	537,433	559,467	582,405	606,284	631,142	657,018	683,956
Total Expenses (RM/year)		**648,877**	**671,342**	**694,657**	**718,857**	**743,975**	**770,050**	**797,119**	**825,221**	**854,397**	**884,690**
Revenue from CER		0	0	0	0	0	0	0	0	0	0
Revenue from Recyclables Sales (MYR)		278,568	283,304	288,120	293,018	297,999	303,065	308,217	313,457	318,786	324,205
Revenue from Cover Soil displacement		152,850	155,448	158,091	160,779	163,512	166,292	169,119	171,994	174,917	177,891
Total revenue from project activities (RM/year)		**431,418**	**438,752**	**446,211**	**453,796**	**461,511**	**469,357**	**477,336**	**485,450**	**493,703**	**502,096**
Depreciation		436,865	436,865	436,865	436,865	436,865	436,865	436,865	436,865	436,865	436,865
EBIT (Revenue - Expenses-Depreciation)		*-654,324*	*-669,455*	*-685,311*	*-701,925*	*-719,329*	*-737,559*	*-756,648*	*-776,635*	*-797,559*	*-819,459*
Loss carried forward		*-654,324*	*-1,323,779*	*-2,009,090*	*-2,711,015*	*-3,430,345*	*-4,167,903*	*-4,924,551*	*-5,701,186*	*-6,498,745*	*-7,318,204*
Income TAX	25%	0	0	0	0	0	0	0	0	0	0
Nett Income (EBIT - income tax)		-654,324	-669,455	-685,311	-701,925	-719,329	-737,559	-756,648	-776,635	-797,559	-819,459
Free Cash Flow (Net Income + Depreciation)	-4,368,650	-217,459	-232,590	-248,446	-265,060	-282,464	-300,694	-319,783	-339,770	-360,694	-382,594
IRR (20 years) without CDM	**#NUM!**										

IRR for revenue from cover soil displacement +10%

Total Project Cost	-4,368,650	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Maintenance & Repair cost		91,843	93,405	94,992	96,607	98,250	99,920	101,619	103,346	105,103	106,890
Electricity cost		8,634	8,781	8,930	9,082	9,236	9,393	9,553	9,715	9,881	10,049
Fuel (Diesel) cost		72,000	73,224	74,469	75,735	77,022	78,332	79,663	81,018	82,395	83,796
Labour cost		476,400	495,932	516,266	537,433	559,467	582,405	606,284	631,142	657,018	683,956
Total Expenses (RM/year)		**648,877**	**671,342**	**694,657**	**718,857**	**743,975**	**770,050**	**797,119**	**825,221**	**854,397**	**884,690**
Revenue from CER		0	0	0	0	0	0	0	0	0	0
Revenue from Recyclables Sales (MYR)		309,520	314,782	320,133	325,575	331,110	336,739	342,464	348,285	354,206	360,228
Revenue from Cover Soil displacement		168,135	170,993	173,900	176,856	179,863	182,921	186,030	189,193	192,409	195,680
Total revenue from project activities (RM/year)		**477,655**	**485,775**	**494,033**	**502,432**	**510,973**	**519,660**	**528,494**	**537,478**	**546,616**	**555,908**
Depreciation		436,865	436,865	436,865	436,865	436,865	436,865	436,865	436,865	436,865	436,865
EBIT (Revenue - Expenses-Depreciation)		*-608,087*	*-622,432*	*-637,489*	*-653,290*	*-669,867*	*-687,256*	*-705,490*	*-724,607*	*-744,646*	*-765,647*
Loss carried forward		*-608,087*	*-1,230,519*	*-1,868,008*	*-2,521,297*	*-3,191,165*	*-3,878,420*	*-4,583,910*	*-5,308,517*	*-6,053,164*	*-6,818,811*
Income TAX	25%	0	0	0	0	0	0	0	0	0	0
Nett Income (EBIT - income tax)		-608,087	-622,432	-637,489	-653,290	-669,867	-687,256	-705,490	-724,607	-744,646	-765,647
Free Cash Flow (Net Income + Depreciation)	-4,368,650	-171,222	-185,567	-200,624	-216,425	-233,002	-250,391	-268,625	-287,742	-307,781	-328,782
IRR (20 years) without CDM	**#NUM!**										

IRR for revenue from cover soil displacement -10%

Total Project Cost	-4,368,650	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Maintenance & Repair cost		91,843	93,405	94,992	96,607	98,250	99,920	101,619	103,346	105,103	106,890
Electricity cost		8,634	8,781	8,930	9,082	9,236	9,393	9,553	9,715	9,881	10,049
Fuel (Diesel) cost		72,000	73,224	74,469	75,735	77,022	78,332	79,663	81,018	82,395	83,796
Labour cost		476,400	495,932	516,266	537,433	559,467	582,405	606,284	631,142	657,018	683,956
Total Expenses (RM/year)		**648,877**	**671,342**	**694,657**	**718,857**	**743,975**	**770,050**	**797,119**	**825,221**	**854,397**	**884,690**
Revenue from CER		0	0	0	0	0	0	0	0	0	0
Revenue from Recyclables Sales (MYR)		309,520	314,782	320,133	325,575	331,110	336,739	342,464	348,285	354,206	360,228
Revenue from Cover Soil displacement		137,565	139,904	142,282	144,701	147,161	149,662	152,207	154,794	157,426	160,102
Total revenue from project activities (RM/year)		**447,085**	**454,685**	**462,415**	**470,276**	**478,271**	**486,401**	**494,670**	**503,080**	**511,632**	**520,330**
Depreciation		436,865	436,865	436,865	436,865	436,865	436,865	436,865	436,865	436,865	436,865
EBIT (Revenue - Expenses-Depreciation)		*-638,657*	*-653,521*	*-669,107*	*-685,445*	*-702,570*	*-720,514*	*-739,314*	*-759,006*	*-779,630*	*-801,225*
Loss carried forward		*-638,657*	*-1,292,179*	*-1,961,286*	*-2,646,731*	*-3,349,301*	*-4,069,814*	*-4,809,128*	*-5,568,134*	*-6,347,764*	*-7,148,989*
Income TAX	25%	0	0	0	0	0	0	0	0	0	0
Nett Income (EBIT - income tax)		-638,657	-653,521	-669,107	-685,445	-702,570	-720,514	-739,314	-759,006	-779,630	-801,225
Free Cash Flow (Net Income + Depreciation)	-4,368,650	-201,792	-216,656	-232,242	-248,580	-265,705	-283,649	-302,449	-322,141	-342,765	-364,360
IRR (20 years) without CDM	**#NUM!**										

Annex 4

MONITORING INFORMATION

1. Sampling plan for waste-composition

The composition of incoming waste will be done by sampling fresh waste at least annually, in accordance with the “Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site”. The purpose of these measurements is to determine the fraction of each waste stream within the total waste input going to the composting facility. In accordance with the tool the following waste-streams are to be distinguished:

- Wood and wood products
- Pulp, paper and cardboard (other than sludge)
- Food, food waste, beverages and tobacco (other than sludge)
- Textiles
- Garden, yard and park waste
- Inorganic: Glass, plastic, metal & other inert waste

For each of the sample, waste from the freshly arrived solid waste will be collected from randomly selected for incoming trucks. 100Kg (approx.) sample will be collected from each truck and a quarter of sample (25kg approx.) will be retained for sampling. Physical inspection of the waste in the truck would be required to see that the waste is of uniform nature. Using quartering method about 100 kg of composite sample will be drawn out for the original solid waste. The waste should be sorted to segregate to the required constituents for weighing of each component. This would be done at the site itself. The parameters would be noted down in format as provided in table below. The record should be maintained for all sample analysed for verification.

Composition of MSW

Sample No.		
Date		
S. No.	**Waste Type**	**Weight in Grams**
1	Wood and wood products	
2	Pulp, paper and cardboard (other than sludge)	
3	Food, food waste, beverages and tobacco (other than sludge)	
4	Textiles	
5	Garden, yard and park waste	
6	Inorganic: Glass, plastic, metal & other inert waste	

To ensure that different categories are interpreted similar each time, project manager shall prepare an instruction-book. The instruction book will contain pictures and descriptions what’s included in each waste-category.

The sampling plan for determination of the possible anaerobic circumstances within the composting piles is based upon the statistical methods used by Project 2778 Composting of Organic Content of Municipal solid Waste in Lahore (Pakistan), Project 1087 Composting of Organic Waste in Wuzhou (China) and Project 0169 Composting of Organic Waste in Dhaka (Bangladesh). The equation used in both projects is reproduced below and has been used to estimate the number of samples in this project as well.

$$n = \frac{t_p^2 * p * (1- p) * N \qquad 1}{t_p^2 * p * (1- p) + (N-1) * y^2}$$

Where:
n : Sample Size
t_p : 1.96 for 95% Confidence Interval
N : Population size
p : for the true proportion which as a conservative is set as 0.5
y : Sampling error

Required sampling amounts for 95% confidence level and 20% sampling error

Amount of organic waste kg/day	**Amount of sampling kg**	
	20% error	**10% error**
100	20	49
250	22	70
500	23	81
750	23	85
1000	23	88
2500	24	93
5000	24	94
10000	24	95
25000	24	96
50000	24	96
100000	24	96
1000000	24	96
100000000	24	96

The compost plant for the project activities will receive 50,000 kg per day. Hence, a minimum of 24kg is required in order to get a representative impression of the waste-input with a 20% sampling error.

2. Sampling plan for determination of oxygen deficiency

The sampling plan for determination of the possible anaerobic circumstances within the composting piles is based upon the above-mentioned statistical methods.

$$n = \frac{t_p^2 * p * (1- p) * N \qquad 1}{t_p^2 * p * (1- p) + (N-1) * y^2}$$

Where:
n : Sample Size

t_p : 1.96 for 95% Confidence Interval
N : Population size
p : for the true proportion which as a conservative is set as 0.5
y : Sampling error

For this case, the population is the “air-molecules within the garbage/composting piles”. Therefore the population size is extremely high and it can be calculated that for y (sampling error) = 20%, the sample size should be 24 samples per day. With 300 working days per annum, this amounts to 7200 annual measurements.