



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

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**SECTION A. General description of project activity****A.1. Title of the project activity:**

The title of the project activity: LFG Collection & Utilization Project in Ipoh

Version number: 01

Date: 8/3/2010

**A.2. Description of the project activity:**

The Landfill is located in the northeast of Ipoh City, Perak State, Malaysia.

The landfill site has a total area of 40 ha and receives approximately 220,000 tons per year of domestic and non-hazardous industrial waste by open-dumping. LEETUCK CONSTRUCTION SDN. BHD.

(hereinafter, LT) operates the landfill, including collection and transportation of municipal solid waste (hereinafter, MSW). But, the new landfill site is planed to open and this existing one will be closed in 2012. And now, the LFG is not collected (Atmospheric release).

The project involves the installation of a gas collection pipeline system, a gas pumping system, a flaring system and gas engine generators. The recovery volume of landfill gas (Methane gas only) in 2013, the first year of the proposed project, is estimated to be approximately 4,000 tons / year .The gas engines will combust landfill gas, which contains nearly 50% of methane, to produce electricity and export it to the grid.

The project is intended to play an important role in the safety closure of the landfill site by eliminating the emission of landfill gas and prevent odd smell from spreading. The project is consistent with the criteria mentioned in the ninth Malaysian Plan and its Mid-Term Review by Economic Planning Unit in Malaysia on performance for sustainable development for CDM project in Malaysia.

The project is expected to contribute to;

- ▶ Destruction of methane by collecting landfill gas formed inside the accumulated waste in the landfill site.
- ▶ Reduction of carbon dioxide emitter by replacing electricity generated from fossil fuel.

**A.3. Project participants:****Table 1: Project participants**

<b>Name of Party involved (host) indicates a host Party)</b>	<b>Private and/or public entity (ies) project participants (as applicable)</b>	<b>Kindly indicate if the party involved wishes to be considered as project participant (Yes/No)</b>
Malaysia (host)	LEE TUCK CONSTRUCTION SDN.BHD. (LT)	No
	Special Purpose Company (SPC) formed by LT and Midac CO., LTD	Yes
Japan	Midac CO., LTD	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 project activity will take place at 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 located about 200 km to the north of Kuala Lumpur.

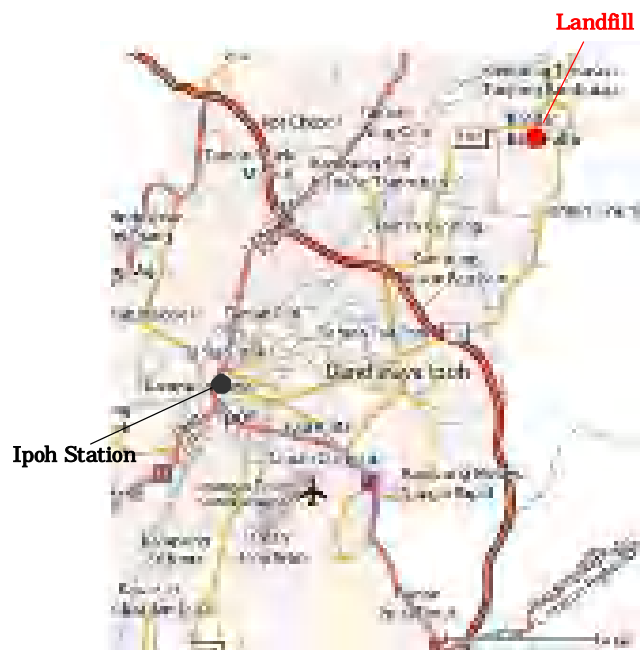


Figure1: Map of Malaysia and Ipoh City

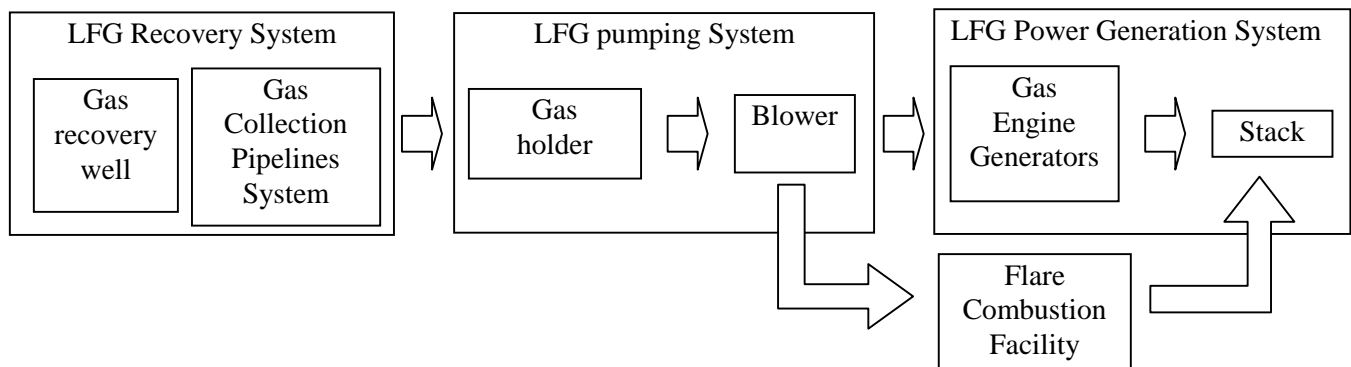
**A.4.2. Category(ies) of project activity:**

Sectoral scope 13: Waste handling and disposal.  
Landfill gas recovery and conversion to electricity.

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

The project will involve proven technology and hardware for the recovery, collection and pumping landfill gas (LFG) and power generation using the gas. In addition, since gas recovery volume is essential to the project viability, optimization of gas recovery well arrangements in the disposed waste is made by applying a newly developed method based on the site investigation.

The facilities proposed for the project consist of an LFG recovery system, an LFG pumping system, and LFG flaring system as shown in Figure 2. The detail of each system follows.



**Figure 2: Overview flowchart of the LFG facility**

**LFG recovery system**

It is noted that a critical factor that controls methane gas emissions is a covering layer of the landfill surface as well as recovery wells. In order to maximize the methane gas recovery, the landfill area of the project will be covered with dense soil of thickness more than 0.5m.

In the LFG recovery system, LFG is collected through gas recovery wells located at the landfill area and delivered to LFG flaring system and power generation system by LFG collection pipelines.

**LFG pumping system**

The LFG pumping system consists of blowers with appropriate control system, which pumps and brings LFG to the power generation system at the optimal rate and quality. In addition, in the case of maintenance of a gas engine, etc., the LFG is led to flare combustion equipment.

**LFG power generation system**

Gas engine generators combust the gas as fuel and generate electricity. All the electric power generated by the facility after its in-house consumption is sold to Tenaga Nasional Berhad (TNB), a regional power generator and distributor.

**Flare combustion facility**

The flare combustion facility burns excessive LFG beyond the gas engine capacity and collected LFG during maintenance (inspection and malfunction) of the gas engine generators.

**Facilities in summary**

In summary, the following components are installed in the LFG recovery, storage and power generation

Facilities:

- ▶ Vertical wells with perforated pipes
- ▶ Horizontal pipeline system conveying the collected LFG
- ▶ A blower
- ▶ Flare combustion facility
- ▶ Gas engine generators
- ▶ Step-up transformers
- ▶ Transmission line to the grid
- ▶ Monitoring equipment

The employed technology is environmentally sound, because almost no alteration is added to the present state of the landfill site except boring the vertical holes of small size.

<b>A.4.4. Estimated amount of emission reductions over the chosen <u>crediting period</u>:</b>
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**Table 2: Estimation of emission reduction**

Year	Annual estimation of emission reductions in tons of CO <sub>2</sub> e
2013	91,505
2014	74,316
2015	61,789
2016	52,875
2017	45,809
2018	40,320
2019	35,956
<b>Total estimated reductions (tons of CO<sub>2</sub>e)</b>	402,570
<b>Total number of years in first crediting period</b>	7
<b>Annual average estimated reductions, first crediting period (tons of CO<sub>2</sub>e)</b>	57,510

<b>A.4.5. Public funding of the <u>project activity</u>:</b>
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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:**

ACM0001 - Version 11 “Consolidated baseline methodology for landfill gas project activities”,–  
Revision to the approved consolidated baseline methodology.

“Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site -  
Version 4

“Tool to determine project emissions from flaring gases containing methane”

“Tool to calculate project or leakage CO<sub>2</sub> emissions from fossil fuel combustion” Version 2

“Tool for the demonstration and assessment of additionality” Version 5.2

“Tool to calculate baseline, project and/or leakage emissions from electricity consumption” Version 1

“Tool to calculate the emission factor for an electricity system” Version 2

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

ACM 0001 is applicable to landfill gas capture project activities, where the baseline scenario is partial or total atmospheric release of the gas and the project activities include situations such as:

- a) The captured gas is flared; and/or
- b) The captured gas is used to produce energy (e.g. electricity/thermal energy);
- c) The captured gas is used to supply consumers through natural gas distribution network. If emissions reductions are claimed for displacing natural gas, project activities may use approved methodology AM0053.

The project activity corresponds to situations a) and b): the collected landfill gas will be flared and used to produce electricity, thus ACM0001 is applicable for this project.

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

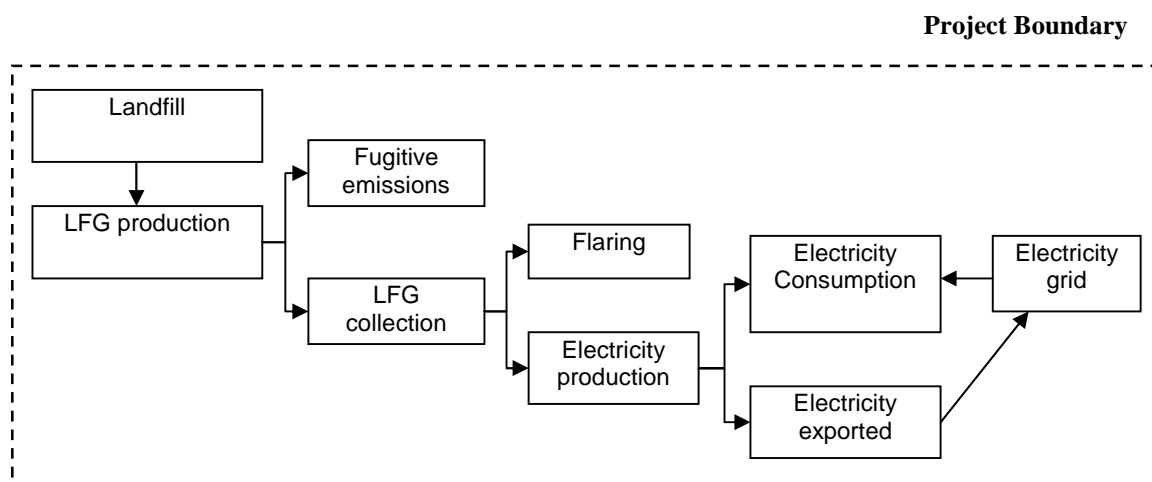
ACM 0001 defines the project boundary as the site of the project activity where the gas is captured and destroyed/used.

In addition, since the renewable electricity exported by the project would have been generated by power generation sources connected to the grid, the project boundary includes all these power generation sources.

The gases and sources relevant to the Project are listed below.

**Table 3: 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	CO <sub>2</sub>	No	CO <sub>2</sub> emissions from the decomposition of organic waste are not accounted.
		CH <sub>4</sub>	Yes	The major source of emissions in the baseline
		N <sub>2</sub> O	No	N <sub>2</sub> O emissions are small compared to CH <sub>4</sub> emissions from landfills. Exclusion of this gas is conservative.
	Emissions from electricity consumption	CO <sub>2</sub>	Yes	Electricity is consumed from the grid in the baseline scenario.
		CH <sub>4</sub>	No	Excluded for simplification. This is conservative.
		N <sub>2</sub> O	No	Excluded for simplification. This is conservative.
	Emissions from thermal energy generation	CO <sub>2</sub>	No	Thermal energy generation is not included in the project activity
		CH <sub>4</sub>	No	Excluded for simplification. This is conservative.
		N <sub>2</sub> O	No	Excluded for simplification. This is conservative.
Project Activity	On-site fossil fuel consumption due to the project activity other than for electricity generation	CO <sub>2</sub>	No	No on-site fossil fuel consumption.
		CH <sub>4</sub>	No	Excluded for simplification. This emission source is assumed to be very small.
		N <sub>2</sub> O	No	Excluded for simplification. This emission source is assumed to be very small.
	Emissions from on-site electricity use	CO <sub>2</sub>	Yes	Important emission source.
		CH <sub>4</sub>	No	Excluded for simplification. This emission source is assumed to be very small.
		N <sub>2</sub> O	No	Excluded for simplification. This emission source is assumed to be very small.



**Figure 3: Project boundary of the proposed project**

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

According to the approved methodology ACM0001, the baseline scenario of the project activity is defined as the following procedures, using the “Tool for the demonstration and assessment of additionality (version 5.2)”

**STEP 1: Identification of alternative scenarios**

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

Alternatives for the disposal/treatment of the waste in the absence of the project activity, i.e. the relevant scenario for estimating baseline methane emissions, to be analysed include:

LFG1. The project activity (i.e. capture of landfill gas and its flaring and/or use) undertaken without being registered as a CDM project activity;

LFG2. Atmospheric release of the landfill gas or partial capture of landfill gas and destruction to comply with regulations or contractual requirements, or to address safety and odd smell concerns.

Since the project activity also includes LFG for generation of electricity for export to a grid, realistic and credible alternatives for power generation should also be separately determined as below:

- P1: Power generated from landfill gas undertaken without being registered as CDM project activity;
- P2: Existing or construction of a new on-site or off-site fossil fuel fired cogeneration plant;
- P3: Existing or construction of a new on-site or off-site renewable based cogeneration plant;





P4: Existing or construction of a new on-site or off-site fossil fuel fired captive power plant;  
P5: Existing or construction of a new on-site or off-site renewable based captive power plant;  
P6: Existing and/or new grid-connected power plants.

As the project activity does not aim at producing heat for nearby industries or on-site use, existing or construction of a cogeneration plant is not part of the baseline scenario. Also there is no existing nor construction plan for fossil fuel based or renewable based cogeneration plant nearby. Hence alternatives P2 and P3 are not taken into consideration in identification of baseline scenario.

Similarly, there is no existing on-site or off-site renewable based captive power plant. The government of Malaysia encourages development on renewable energy, however, currently this kind of renewable projects have not been implemented yet. Furthermore, Renewable sources other than LFG are not economically feasible for the project site; therefore P5 is not a realistic and credible scenario.

As a grid connection already exists on the landfill site, construction of a new onsite fossil fuel fired captive power plant is not as economically competitive as purchasing power from the grid, and not realistic alternatives to the Project activity. Furthermore, the power needs at the landfill site are minimal and therefore do not justify the construction of a new fossil fuel fired captive power plant, Thus, alternatives P4 can be discarded.

#### ***Sub-step 1b. Consistency with mandatory laws and regulations***

Currently, in Malaysia, there are no national or regional regulatory requirements to collect and/or burn landfill gas. Hence alternative LFG 1 and LFG2 are in compliance with national laws and regulations. P1 complies with all laws and regulations but is not required by laws and regulations. P6 complies with all laws and regulations

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

The baseline for the energy source is the electricity generated by the power plants connected to Malaysian National Grid, which is mainly consist of fossil fuel based power plants (coal and gas), as well as renewable based power plants (hydro). This grid covers whole Peninsula Malaysia, and there is no restriction of baseline fuel to be used.

As described above, plausible alternative scenarios for the Project are LFG1, LFG2 for LFG utilization and P1, P6 for power generation.

### **STEP 3: Investment analysis**

If power generated from LFG is undertaken without being registered as CDM project activity (P1), this is not a viable alternative because of the low electricity tariff in Malaysia. In Malaysia, the tariff of sale of electricity to the only national power supplier, Tenaga National Malaysia, is low. The current sale price of 21 Malaysia sen per KWh (US \$0.07) is not attractive to project owner in view of the capital



investment of US \$ 3 millions and uncertainty of the landfill gas production. Even when combined with Scenario LFG1, the IRR is determined to be negative, let alone when combined with Scenario LFG2. Therefore, it can be clearly stated that scenario P1 is economically unattractive, and shall also be excluded from further consideration.

Scenario LFG1 requires installation of LFG collection system in the landfill site, and all necessary expenses to develop and implement the proposed project activity would be additional cost for the project owner. Furthermore, if LFG was just flared without being utilized to generate electricity, the Project would not be able to obtain additional income, thus LFG1 is not financially attractive. Therefore, LFG1 cannot be realistic alternative, and thus can be eliminated from consideration as baseline scenario.

Based on the above analysis, P1 and LFG1 can be discarded from the possible baseline scenarios. Hence, LFG2 (atmospheric release of the landfill gas) and P6 (electricity obtained from the Grid) are the only remaining credible and plausible scenarios, and have been identified as the baseline scenario.

**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):**

In Malaysia, though the utilization of renewable energy is recommended, it is difficult to start such projects in terms of financial situation. In addition, there is a landfill LFG is released to the atmosphere in Ipoh City.

Then, the project participants plan to capture and utilize LFG for the power generation with being registered as CDM project activity.

Additionality determination is done by using the latest version of the CDM “*Tool for the demonstration and assessment of additionality*”.

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

In line with the applied methodology ACM0001, realistic and credible alternatives available for the disposal/treatment of the waste in the absence of the project activity are identified as follows, and all are in compliance with the mandatory laws and regulations that are set by the Government of Malaysia.

Scenario1 (LFG2 + P6): Atmospheric release of LFG, no capture based on legislation, etc. (Maintenance of status quo);

Scenario2 (LFG1 + P6): The proposed activity is undertaken without being registered as a CDM project activity, capturing the LFG and combusting by flaring;

Scenario3 (LFG1 + P1): Power generated from LFG undertaken without being registered as a CDM project activity.

**Step 2: Investment analysis**

The purpose of this step is to determine whether the proposed Project activity is financially less attractive than other alternatives without revenues from the sale of CERs. The investment analysis was implemented in the following steps:

***Sub-step 2a. Determine appropriate analysis method***

The Project generates income from its electricity sales, in addition to the expected CDM revenue. Consequently, Option I (Simple Cost Analysis) is not appropriate. Option II (Investment Comparison Analysis) is also not appropriate as there is no comparable investment alternative at the proposed landfill sites available to the project proponent. Option III (Benchmark Analysis) is therefore deemed as the most appropriate analysis method.

***Sub-step 2b. Option III. Apply benchmark analysis***

The IRR was chosen as the relevant financial indicator for the Project, and the benchmark is the coupon rate issued by the government of Malaysia which is 5.094 %. (Issued November, 2009)

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

The IRR of the proposed project without CDM revenue (LFG1 and P1) and with CDM revenue are calculated using the parameters listed in the following tables.

Item	Description
Project Period	7 years
Waste Amount	No change during the project (600t/d)
Amount of Loans	None
Inflation Rate	1.12% (as of 2009)
Corporate Tax	25%
Depreciation Period	5 years

Expense	
Initial Investment	10,500,000 RM
O&M Cost	653,000 RM/year
Expense Total (7 years)	15,073,000 RM
Income	
CER Sales	33 RM/tCO <sub>2</sub>
Electricity Sales	0.21 RM/kWh
Income Total (7 years)	23,242,000 RM
Project IRR	
With CER	5.2 %
Without CER	negative

As shown in the table above, the project IRR is negative without CER. With the additional revenue from sale of carbon credits from CDM, the IRR increases to acceptable rates. 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 viability of the proposed project is sound and tenable with those reasonable variations in the critical assumptions. The critical assumptions include:

Expense : Range from –5% to –15% compared to the original condition  
 Income : Range from +5% to +15% compared to the original condition  
 (Income only includes revenues from electricity sales)

These parameters were selected as being the most likely to fluctuate over time due to external factors. The results of the sensitivity analysis are as given below:

		Expense		
		-15%	-10%	-5%
Income	+5%	Negative	Negative	Negative
	+10%	Negative	Negative	Negative
	+15%	-21.6%	Negative	Negative

As is evident in the table, even with the decreased expense and increased income, the IRR of the project is negative.

Thus, the sensitivity analysis reveals that even with significant changes in various parameters, the project IRR does not cross benchmark rate. Therefore, the project is additional and is not a business as usual scenario. The project can become financially attractive only with the CDM benefit.

**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 project activity:**

Currently, LFG collection project is not carried out on landfill sites in Malaysia, except those developed under CDM. The common method for waste disposal is open dumps and landfills, though there are few landfills engineered and having gas venting or collection systems. Thus prevailing practice in Malaysia is free venting of LFG.

Although the government of Malaysia encourages the development of renewable energy, there is no obligation for landfill operators to promote productive use of LFG for heat or electricity generation. In addition, because of high Initial investment, utilization of LFG for electricity generation project without CDM benefit has no profitability as an independent project. Taking into consideration its technical difficulty and no financial feasibility capturing and utilization of LFG is not attractive for project developer. Consequently, collection and utilization of LFG has not been practiced in Malaysia besides the CDM projects.

**Sub-step 4b. Discuss any similar options that are occurring:**

As stated in sub-step 4a, there are no similar options commonly occurring in the Host country. The common practice in Malaysia is disposal of waste in the landfill without the capture of LFG, and capture and utilization of LFG 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:**

The emission reductions resulting from the capture and combustion of methane are calculated in accordance with ACM0001 “Consolidated baseline methodology for landfill gas project activities” Version 11.

**1. Baseline emissions**

The baseline emissions are calculated as follows:

$$BE_y = (MD_{project,y} - MD_{BL,y}) * GWP_{CH_4} + EL_{LFG,y} * CEF_{elec,BL,y} + ET_{LFG,y} * CEF_{ther,BL,y} \quad (1)$$

As the proposed project activity does not include a thermal energy component, equation can be modified for simplification.

$$BE_y = (MD_{project,y} - MD_{BL,y}) * GWP_{CH_4} + EL_{LFG,y} * CEF_{elec,BL,y} \quad (2)$$

Where:

- $BE_y$  : Baseline emissions in year y (tCO<sub>2</sub>e/yr)  
 $MD_{project,y}$  : The amount of methane that would have been destroyed/combusted during the year, in tons of methane (tCH<sub>4</sub>) in project scenario  
 $MD_{BL,y}$  : The amount of methane that would have been destroyed/combusted during the year in the absence of the project due to regulatory and/or contractual requirement, in tons of methane (tCH<sub>4</sub>)  
 $GWP_{CH_4}$  : Global Warming Potential value for methane for the first commitment period is 21 tCO<sub>2</sub>e/tCH<sub>4</sub>  
 $EL_{LFG,y}$  : Net quantity of electricity produced using LFG, which in the absence of the project activity would have been produced by power plants connected to the grid or by an on-site/off-site fossil fuel based captive power generation, during year y, in megawatt hours (MWh)  
 $CEF_{elec,BL,y}$  : CO<sub>2</sub> emissions intensity of the baseline source of electricity displaced, in tCO<sub>2</sub>e/ MWh.

**(1) Amount of methane that would have been destroyed/combusted during the year y in the absence of the project due to regulatory and/or contractual requirements ( $MD_{BL,y}$ )**

The amount of methane that would have been destroyed/combusted during the year y in the absence of the project due to regulatory and/or contractual requirements is calculated as follows:

$$MD_{BL,y} = MD_{project,y} * AF \quad (3)$$

Where:

AF : Adjustment Factor

ACM0001 provides the guidance on how to estimate AF. AF should be considered in cases where a specific system for collection and destruction of methane is mandated by regulatory or contractual requirements or is undertaken for other reasons, the ratio of the destruction efficiency of the baseline system to the destruction efficiency of the system used in the project activity shall be used. For the proposed project, there is no contractual requirement. As explained before, the flaring and treatment of LFG are not widely enforced and the common practice in Malaysia remains venting LFG. Therefore, AF is zero. Then  $MD_{BL,y}$  is 0.

**(2) Methane destroyed by the project activity ( $MD_{project,y}$ )**

The amount of methane that would have been destroyed/combusted during year y is calculated as follows since there are neither thermal energy generation nor LFG feeding to pipeline:

$$MD_{project,y} = MD_{flared,y} + MD_{electricity,y} \quad (4)$$

Where:

$MD_{flared,y}$  : Quantity of methane destroyed by flaring (tCH<sub>4</sub>)

$MD_{electricity,y}$  : Quantity of methane destroyed by generation of electricity (tCH<sub>4</sub>)

The amount of methane destroyed/combusted by flaring is calculated as:

$$MD_{flared,y} = (LFG_{flare,y} * w_{CH_4,y} * D_{CH_4}) - (PE_{flare,y} / GWP_{CH_4}) \quad (5)$$

Where:

$LFG_{flare,y}$  : Quantity of landfill gas fed to the flare(s) during the year measured in cubic meters (m<sup>3</sup>)

$w_{CH_4,y}$  : Average methane fraction of the landfill gas as measured during the year and expressed as fraction (m<sup>3</sup>CH<sub>4</sub>/m<sup>3</sup>LFG)

$D_{CH_4}$  : Methane density expressed in tons of methane per cubic meter of methane (tCH<sub>4</sub>/m<sup>3</sup>CH<sub>4</sub>)  
\*At standard temperature and pressure (0 °C, 1.013 bar), the density of methane is 0.0007168 tCH<sub>4</sub>/m<sup>3</sup>CH<sub>4</sub>

$PE_{flare,y}$  : Project emissions from flaring of the residual gas stream in year y (tCO<sub>2</sub>e) determined following the procedure described in the "Tool to determine project emissions from flaring gases containing Methane". If methane is flared through more than one flare, the  $PE_{flare,y}$  shall be determined for each flare using the tool

Determination of  $PE_{flare,y}$ :

Project emissions from flaring will be calculated and monitored according to the procedures described in the “Tool to determine project emissions from flaring gases containing methane”, using the 90 % default value for the methane destruction efficiency of the flare.

$PE_{flare,y}$  is calculated as follows:

$$PE_{flare,y} = \sum_{(h = 1 - 8760)} TM_{RG,h} * (1 - \eta_{flare,h}) * GWP_{CH4} / 1000 \quad (6)$$

Where:

$TM_{RG,h}$  :Mass flow rate of methane in the residual gas in the hour h (kg/h)

$\eta_{flare,h}$  :Flare efficiency in hour h

The quantity of methane destroyed by generation of electricity is calculated using the following equation:

$$MD_{electricity,y} = LFG_{electricity,y} * w_{CH4,y} * D_{CH4} \quad (7)$$

Where:

$LFG_{electricity,y}$  :Quantity of landfill gas fed into electricity generator ( $m^3$ )

$w_{CH4,y}$  :Average methane fraction of the landfill gas as measured during the year and expressed as fraction ( $m^3CH_4/m^3LFG$ )

$D_{CH4}$  :Methane density expressed in tons of methane per cubic meter of methane ( $tCH_4/m^3CH_4$ )  
\*At standard temperature and pressure (0 , 1.013 bar), the density of methane is  
0.0007168  $tCH_4/m^3CH_4$

Ex-ante estimation of the amount of methane that would have been destroyed/combusted during the year, in tons of methane

The ex-ante estimation of the amount of methane that would have been destroyed/combusted during the year, in tons of methane, will be done with the latest version of the approved “Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site”, considering the following additional equation:

$$MD_{project,y} = BE_{CH4, SWDSy} / GWP_{CH4} \quad (8)$$

Where:  $BE_{CH4,SWDS,y}$  is the methane generation from the landfill in the absence of the project activity at year y ( $tCO_2e$ ), calculated as per the “Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site”.



$$BE_{CH_4,SWDS,y} = \varphi \cdot (1-f) \cdot (1-OX) \cdot \frac{16}{12} \cdot F \cdot DOC_f \cdot MCF \cdot \sum_{x=1}^y \sum_j W_{j,x} \cdot DOC_j \cdot e^{-kj(y-x)} \cdot (1-e^{-kj}) \quad (9)$$

Where:

$MB_y$	is $BE_{CH_4,SWDS,y}$ (tCO <sub>2</sub> e/yr)
$BE_{CH_4,SWDS,y}$	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 <sub>2</sub> e/yr)
$\varphi$	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
$GWP_{CH_4}$	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 $x$ (tons)
$DOC_j$	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

$$W_{j,x} = W_x \times \frac{\sum_{n=1}^z P_{n,j,x}}{z} \quad (10)$$

Where:

$W_{j,x}$	is the amount of organic waste type $j$ prevented from disposal in the SWDS in the year $x$ (tons)
$W_x$	is the total amount of organic waste prevented from disposal in year $x$ (tons)
$P_{n,j,x}$	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 $x$

Once  $BE_{CH_4,SWDS,y}$  is calculated according to the Tool, a collection efficiency is applied to this value in order to reflect the fact that not all methane generated is actually captured by the collection system. The collection efficiency value should consider the physical conditions of this landfill as well as the capping material used to cover the waste, but those parameters are already addressed by the formula used to calculate  $BE_{CH_4,SWDS,y}$ . Therefore, according to the manufacture, collection efficiency is a reasonable factor to use, as it reflects only the efficiency of the system itself (incl. pipes, blower, etc...)





## 2. Project emissions

The project emissions are calculated as follows:

$$PE_y = PE_{EC,y} + PE_{FC,y} \quad (11)$$

Where:

$PE_{EC,y}$  :project emissions from electricity consumption by the project activity during the year y (tCO<sub>2</sub>e/yr)

$PE_{FC,y}$  :project emissions from heat consumption by the project activity during the year y (tCO<sub>2</sub>e/yr)

### (1) Project emissions from electricity consumption

Determination of  $PE_{EC,y}$  is done with the approved “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”, using the following equation;

$$PE_{EC,y} = EC_{PJ,y} * EF_{grid,y} * (1 + TDL_y) \quad (12)$$

$EC_{PJ,y}$  :Quantity of electricity consumed in the project activity during the year y (MWh)

$EF_{grid,y}$  :Emission factor for the grid in year y(tCO<sub>2</sub>e/MWh)

$TDL_y$  :Average technical transmission and distribution losses in the grid in year y for the voltage level at which electricity is obtained from the grid at the project site.

### (2) Project emissions from heat consumption

As the only fossil fuel to be used will be diesel, project emissions from fuel combustion is calculated using the following equation:

$$PE_{FC,j,y} = FC_{diesel,y} * COEF_{diesel,y} \quad (13)$$

Where:

$FC_{diesel,y}$  :Quantity of diesel combusted during the year y

$COEF$  :CO<sub>2</sub> emission coefficient of diesel during the year y

## 3. Leakage emissions:

No leakage effects need to be accounted under this methodology.



#### 4. Emission reductions

According to methodology ACM0001 version 11 the greenhouse gas emission reductions achieved by the project activity during a given year “y” ( $ER_y$ ) shall be estimated as follows:

$$ER_y = BE_y - PE_y \quad (14)$$

Where:

$ER_y$  : Emission reductions in year y (tCO<sub>2</sub>e/yr)

$BE_y$  : Baseline emission in year y (tCO<sub>2</sub>e/yr)

$PE_y$  : Project emission in year y (tCO<sub>2</sub>e/yr)

<b>B.6.2. Data and parameters that are available at validation:</b>
---

<b>Data / Parameter:</b>	<b>Regulatory requirements relating to landfill gas</b>
Data unit:	--
Description:	Regulatory requirements relating to landfill gas
Source of data used:	National legislation and mandatory regulations
Value applied:	0 %
Justification of the choice of data or description of measurement methods and procedures actually applied :	The information will be recorded annually, to be used for changes to the adjustment factor (AF) or directly $MD_{BL,y}$ at renewal of the credit period. Relevant regulations for LFG project activities shall be updated at renewal of each credit period. Changes to regulation should be converted to the amount of methane that would have been destroyed/combusted during the year in the absence of the project activity ( $MD_{BL,y}$ ).
Any comment:	

<b>Data / Parameter:</b>	<b>GWP<sub>CH4</sub></b>
Data unit:	tCO <sub>2</sub> e/tCH <sub>4</sub>
Description:	Global warming potential of CH <sub>4</sub>
Source of data used:	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value applied:	21
Justification of the choice of data or description of measurement methods and procedures actually applied :	21 for the first commitment period.
Any comment:	

<b>Data / Parameter:</b>	<b>D<sub>CH4</sub></b>
Data unit:	tCH <sub>4</sub> /m <sup>3</sup> CH <sub>4</sub>
Description:	Methane Density
Source of data used:	The methodology
Value applied:	See Annex3



Justification of the choice of data or description of measurement methods and procedures actually applied :	At standard temperature and pressure (0 degree Celsius and 1,013 bar) the density of methane is 0.0007168 tCH <sub>4</sub> /m <sup>3</sup> CH <sub>4</sub>
Any comment:	

<b>Data / Parameter:</b>	$\eta_{\text{flare,h}}$
Data unit:	-
Description:	Flare efficiency in the hour h
Source of data used:	“Tool to determine project emissions from flaring gases containing methane”
Value applied:	90 %
Justification of the choice of data or description of measurement methods and procedures actually applied :	Default value as per “Tool to determine project emissions from flaring gases containing methane”.
Any comment:	As and when the entire equipment for continuous measurement of the methane destruction efficiency of the flare will be installed, the actual flare efficiency will be monitored continuously <i>ex-post</i> , and the default vale will no longer be used.

<b>Data / Parameter:</b>	$BE_{\text{CH}_4,\text{SWDS},y}$
Data unit:	tCO <sub>2</sub> e/yr
Description:	Methane generation from the landfill in the absence of the project activity at year y
Source of data used:	Calculated as per the “ <i>Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site</i> ”.
Value applied:	See Annex3
Justification of the choice of data or description of measurement methods and procedures actually applied :	As per the “ <i>Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site</i> ”.
Any comment:	

<b>Data / Parameter:</b>	$\phi$
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 presented by the tool.
Any comment:	

<b>Data / Parameter:</b>	<i>f</i>
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:	

<b>Data / Parameter:</b>	<i>OX</i>
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:	

<b>Data / Parameter:</b>	<i>F</i>
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.
Any comment:	

<b>Data / Parameter:</b>	<b><math>DOC_f</math></b>
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.
Any comment:	

<b>Data / Parameter:</b>	<b><math>MCF</math></b>
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:	

<b>Data / Parameter:</b>	<b><math>DOC_j</math></b>
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:	<p>Following values are applied for each waste type <math>j</math> according to the values provided in the “Tool to determine the methane emissions avoided from dumping waste at a solid waste disposal site”.</p> <table border="1"> <thead> <tr> <th>Waste Type <math>j</math></th> <th><math>DOC_j</math> (% wet waste)</th> <th><math>DOC_j</math> (% dry waste)</th> </tr> </thead> <tbody> <tr> <td>Food</td> <td>15</td> <td>38</td> </tr> <tr> <td>Garden</td> <td>20</td> <td>49</td> </tr> <tr> <td>Wood and Straw</td> <td>43</td> <td>50</td> </tr> <tr> <td>Paper</td> <td>40</td> <td>44</td> </tr> <tr> <td>Textile</td> <td>24</td> <td>30</td> </tr> <tr> <td>Disposable nappies</td> <td>24</td> <td>30</td> </tr> </tbody> </table>	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	Textile	24	30	Disposable nappies	24	30
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																				
Textile	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:																						

<b>Data / Parameter:</b>	$k_j$														
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:	<p>Following values are applied for each waste type <math>j</math> 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 (<math>MAT &gt; 20</math> ) and wet (<math>MAP &gt; 1000\text{mm}</math>), and the decomposition of waste is very fast (Rapidly degrading).</p> <table border="1"> <thead> <tr> <th>Waste Type <math>j</math></th> <th>Tropical (<math>MAT &gt; 20</math> ) Wet (<math>MAP &gt; 1000\text{mm}</math>)</th> </tr> </thead> <tbody> <tr> <td>Food</td> <td>0.4</td> </tr> <tr> <td>Garden</td> <td>0.17</td> </tr> <tr> <td>Wood and Straw</td> <td>0.035</td> </tr> <tr> <td>Paper</td> <td>0.07</td> </tr> <tr> <td>Textile</td> <td>0.07</td> </tr> <tr> <td>Disposable nappies</td> <td>0.17</td> </tr> </tbody> </table>	Waste Type $j$	Tropical ( $MAT > 20$ ) Wet ( $MAP > 1000\text{mm}$ )	Food	0.4	Garden	0.17	Wood and Straw	0.035	Paper	0.07	Textile	0.07	Disposable nappies	0.17
Waste Type $j$	Tropical ( $MAT > 20$ ) Wet ( $MAP > 1000\text{mm}$ )														
Food	0.4														
Garden	0.17														
Wood and Straw	0.035														
Paper	0.07														
Textile	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>Data / Parameter:</b>	<b>TDL<sub>v</sub></b>
Data unit:	%
Description:	Average technical transmission and distribution losses in the grid in year y for the voltage level at which electricity is obtained from the grid at the project site.
Source of data used:	Tenaga Nasional Berhad Annual Report 2007
Value applied:	10%
Justification of the choice of data or description of measurement methods and procedures actually applied :	Calculated value given in a paper “Tenaga Nasional Berhad Annual Report 2007” issued by Tenaga Nasional Berhad.
Any comment:	

<b>Data / Parameter:</b>	<b>EF<sub>grid,BL</sub></b>
Data unit:	tCO <sub>2</sub> e/MWh
Description:	The emission factor for the grid in year y
Source of data used:	Calculated as per the “ <i>Tool to calculate emissions factor for an electric system</i> ”.
Value applied:	0.684
Justification of the choice of data or description of measurement methods and procedures actually applied :	Calculated value given in a paper “Study on Grid Connected Electricity Baselines in Malaysia” issued by Pusat Tenaga Malaysia. The methodology used in the paper is based on the ACM0002 “Consolidated Baseline Methodology for Grid-Connected Electricity”.
Any comment:	

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

#### *Baseline emissions*

Baseline emission is calculated using the equation (2).

$$BE_y = (MD_{project,y} - MD_{BL,y}) * GWP_{CH4} + EL_{LFG,y} * CEF_{elec,BL,y}$$



Ex-ante estimation of  $MD_{project,y}$  is done using the following calculation:

$$MD_{project,y} = BE_{CH_4, SWDS,y} \cdot \epsilon_{PR,y} / GWP_{CH_4} \quad (15)$$

$$BE_{CH_4, SWDS,y} = \varphi \cdot (1-f) \cdot (1-OX) \cdot \frac{16}{12} \cdot F \cdot DOC_f \cdot MCF \cdot \sum_{x=1}^y \sum_j W_{j,x} \cdot DOC_j \cdot e^{-k_j \cdot (y-x)} \cdot (1 - e^{-k_j})$$

Where:

$MB_y$	is $BE_{CH_4, SWDS,y}$ (tCO <sub>2</sub> e/yr)
$BE_{CH_4, SWDS,y}$	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 <sub>2</sub> e/yr)
$\varphi$	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
$GWP_{CH_4}$	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) (0.9)
$DOC_f$	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 $x$ (tons)
$DOC_j$	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

$$W_{j,x} = W_x \times \frac{\sum_{n=1}^z P_{n,j,x}}{z} \quad (16)$$

Where:

$W_{j,x}$	is the amount of organic waste type $j$ prevented from disposal in the SWDS in the year $x$ (tons)
$W_x$	is the total amount of organic waste prevented from disposal in year $x$ (tons)
$P_{n,j,x}$	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 $x$





$\phi$	$f$	$GWP_{CH4}$	$OX$	$F$	$DOC_f$	$MCF$
-	-	-	-	-	-	-
0.9	0	21	0.1	0.5	0.5	1.0
Waste type $j$	$P_{n,j,x}$	$DOC_j$	$k_j$			
	%	%	1/yr			
Food	36	0.15	0.4			
Garden	8	0.20	0.17			
Wood and Straw	6	0.43	0.035			
Paper	14	0.40	0.07			
Textiles	3	0.24	0.07			
Plastics, other inert	32	-	-			

Year x	$W_x$	Year x	$W_x$
	tons/yr		tons/yr
2003	121,806	2013	0
2004	121,806	2014	0
2005	121,806	2015	0
2006	121,806	2016	0
2007	121,806	2017	0
2008	121,806	2018	0
2009	121,806	2019	0
2010	121,806		
2011	121,806		
2012	121,806		

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.

year	$BE_{CH4, SWDS,y}$	$MD_{project,y}$	$MD_{BL,y}$	$EL_{LFG,y}$	$EL_{LFG,y} * CEF_{elec,BL,y}$	BE
	tCO <sub>2</sub> e/yr	tCH <sub>4</sub> /yr	tCH <sub>4</sub> /yr	MWh	tCO <sub>2</sub> e/yr	tCO <sub>2</sub> e/yr
	A	$B=A * \epsilon_{PR,y} / 21$	C	D	E	$B * 21 + E$
1	105177.716	4006.770	0	10774.6	7369.826	91512
2	85590.570	3260.593	0	8553.6	5850.662	74323
3	71315.226	2716.771	0	6934.8	4743.403	61796
4	60708.657	2312.711	0	6308.1	4314.740	52882
5	52657.013	2005.981	0	5395.0	3690.180	45816
6	46402.833	1767.727	0	4685.9	3205.156	40327
7	41428.974	1578.247	0	4121.8	2819.311	35962
Total	463,280.988	17,648.800	0	46773.8	31993.279	402618
$\epsilon_{PR,y} = 80\%$ $CEF = 0.684$						

**Project emissions**

$$PE_y = PE_{EC,y} + PE_{FC,y}$$

$PE_y$	$PE_{EC,y}$	$PE_{FC,y}$
tCO <sub>2</sub> e/yr	tCO <sub>2</sub> e/yr	tCO <sub>2</sub> e/yr
6.837	6.837	0

**Project emissions from electricity consumption ( $PE_{EC,y}$ )**

$$PE_{EC,y} = EC_{PJ,y} * EF_{grid,y} * (1 * TDL_y)$$

$PE_{EC,y}$	$EF_{grid,y}$	$TDL_y$
tCO <sub>2</sub> e/yr	tCO <sub>2</sub> e/MWh	%
6.837	0.684	10

**Project emissions from heat consumption ( $PE_{FC,y}$ )**

There is no consumption of fossil fuel for heat in the project activity. Thus,  $PE_{FC,y} = 0$ .

**Leakage**

According to ACM0001, no leakage effects need to be accounted for this method.

**Emission Reduction**

$$ER_y = BE_y - PE_y - L_y \quad (17)$$

<b>B.6.4 Summary of the ex-ante estimation of emission reductions:</b>
--

**Table 4: Ex-ante estimation of emission reductions**

Year	Estimation of project emissions (tCO <sub>2</sub> e/yr)	Estimation of baseline emissions (tCO <sub>2</sub> e/yr)	Estimation of leakage (tCO <sub>2</sub> e/yr)	Estimation of overall emission reductions (tCO <sub>2</sub> e/yr)
2013	6.837	91511.999	0	91,505
2014	6.837	74323.118	0	74,316
2015	6.837	61795.584	0	61,789
2016	6.837	52881.666	0	52,875
2017	6.837	45815.790	0	45,809
2018	6.837	40327.422	0	40,320
2019	6.837	35962.490	0	35,956
<b>Total</b> (tons of CO <sub>2</sub> e)	47.859	402618.070	0	402,570

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

<b>B.7.1 Data and parameters monitored:</b>	
<i>(Copy this table for each data and parameter)</i>	
<b>Data / Parameter:</b>	<b>LFG<sub>total,y</sub></b>
Data unit:	Nm <sup>3</sup>
Description:	Total amount of landfill gas captured at Normal Temperature and Pressure
Source of data to be used:	Continuous measured by flow meter
Value of data applied for the purpose of calculating expected emission reductions in section B.5	IPCC FOD method is adopted to calculate the theoretically generated LFG, and the recovery efficiency of the proposed project is estimated to be 80 %
Description of measurement methods and procedures to be applied:	Measured by a flow meter. Data to be aggregated monthly and yearly Data will be automatically and continuously monitored and recorded.
QA/QC procedures to be applied:	Flow meters will be subject to a regular maintenance and testing regime to ensure accuracy.
Any comment:	

<b>Data / Parameter:</b>	<b>LFG<sub>flare,y</sub></b>
Data unit:	Nm <sup>3</sup>
Description:	Total amount of landfill gas flared at Normal Temperature and Pressure
Source of data to be used:	Continuous measured by flow meter
Value of data applied for the purpose of calculating expected emission reductions in section B.5	-
Description of measurement methods and procedures to be applied:	Measured by a flow meter. Data to be aggregated monthly and yearly Data will be automatically and continuously monitored and recorded.
QA/QC procedures to be applied:	Flow meters will be subject to a regular maintenance and testing regime to ensure accuracy.
Any comment:	

<b>Data / Parameter:</b>	<b>LFG<sub>electricity,y</sub></b>
Data unit:	Nm <sup>3</sup>



Description:	Total amount of landfill gas combusted in power plant at Normal Temperature and Pressure
Source of data to be used:	Continuous measured by flow meter
Value of data applied for the purpose of calculating expected emission reductions in section B.5	-
Description of measurement methods and procedures to be applied:	Measured by a flow meter. Data to be aggregated monthly and yearly Data will be automatically and continuously monitored and recorded.
QA/QC procedures to be applied:	Flow meters will be subject to a regular maintenance and testing regime to ensure accuracy.
Any comment:	

<b>Data / Parameter:</b>	$PE_{flare,y}$
Data unit:	tCO <sub>2</sub> e,yr
Description:	Project emissions from flaring of the residual gas stream in year y
Source of data to be used:	Calculated as per the “Tool to determine project emissions from flaring gases containing Methane”.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	3,143 tCO <sub>2</sub> e for the first credit period calculated as per the “Tool to determine project emissions from flaring gases containing Methane”.
Description of measurement methods and procedures to be applied:	As per the “Tool to determine project emissions from flaring gases containing Methane”.
QA/QC procedures to be applied:	As per the “Tool to determine project emissions from flaring gases containing Methane”.
Any comment:	

<b>Data / Parameter:</b>	$w_{CH_4}$
Data unit:	m <sup>3</sup> CH <sub>4</sub> / m <sup>3</sup> LFG
Description:	Methane fraction in the landfill gas
Source of data to be used:	Continuous measurement by gas analyzer for CH <sub>4</sub> content in LFG
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.5



Description of measurement methods and procedures to be applied:	Measured by continuous gas quality analyser. The gas quality will be continuously recorded through the data logger. Measurement will be mad on a dry basis.
QA/QC procedures to be applied:	The gas analyser will be subject to regular maintenance, and a testing and calibration regime in accordance with manufacturer specifications to ensure accuracy.
Any comment:	

<b>Data / Parameter:</b>	$\epsilon_{PR,v}$
Data unit:	-
Description:	Efficiency of landfill gas collection and flaring system
Source of data to be used:	Site information
Value of data applied for the purpose of calculating expected emission reductions in section B.5	80 %
Description of measurement methods and procedures to be applied:	The coefficients have only been set for the ex-ante estimation of emission reductions based on the contributing disposal areas during each year.
QA/QC procedures to be applied:	
Any comment:	

<b>Data / Parameter:</b>	$T_t, T_f, T_e$
Data unit:	
Description:	Temperature of the landfill gas at the proximity of each flow meter, including; <ul style="list-style-type: none"> <li>• Total (t)</li> <li>• at each flare (f)</li> <li>• at each engine(e)</li> </ul>
Source of data to be used:	Project participants
Value of data applied for the purpose of calculating expected emission reductions in section B.5	-



Description of measurement methods and procedures to be applied:	<p>Measured continuously by a flow meter which measures the temperature, pressure and flow meter.</p> <p>Data will continuously be registered through a data logger.</p> <p>Measured to determine the density of methane <math>D_{CH_4}</math>.</p> <p>No separate monitoring of temperature is necessary when using flow meters that automatically measure temperature and pressure, expressing landfill gas volumes in normalized cubic meters or when using mass flow meter.</p> <p>Data to be aggregated monthly and yearly.</p> <p>Archived data will be kept during the crediting period and two years after.</p>
QA/QC procedures to be applied:	Measuring instruments will be subjected to a regular maintenance and testing regime in accordance to appropriate national/international standards.
Any comment:	

<b>Data / Parameter:</b>	<b><math>P_t, P_f, P_e</math></b>
Data unit:	Pa
Description:	<p>Pressure of the landfill gas near each flow meter:</p> <ul style="list-style-type: none"> <li>• Total (t)</li> <li>• at each flare (f)</li> <li>• at each engine(e)</li> </ul>
Source of data to be used:	Project participants
Value of data applied for the purpose of calculating expected emission reductions in section B.5	-
Description of measurement methods and procedures to be applied:	<p>Measured continuously by a flow meter which measures the temperature, pressure and flow meter.</p> <p>Data will continuously be registered through a data logger.</p> <p>Measured to determine the density of methane <math>D_{CH_4}</math>.</p> <p>No separate monitoring of temperature is necessary when using flow meters that automatically measure temperature and pressure, expressing landfill gas volumes in normalized cubic meters or when using mass flow meter.</p> <p>Data to be aggregated monthly and yearly.</p> <p>Archived data will be kept during the crediting period and two years after.</p>
QA/QC procedures to be applied:	Measuring instruments will be subjected to a regular maintenance and testing regime in accordance to appropriate national/international standards.
Any comment:	

<b>Data / Parameter:</b>	<b><math>EL_{LFG}</math></b>
Data unit:	MWh
Description:	Net amount of electricity generated using LFG.
Source of data to be used:	Measured by the electricity meter



Value of data applied for the purpose of calculating expected emission reductions in section B.5	The total net amount is estimated at 46773.8 MWh within the first crediting period based on the ex-ante calculation.
Description of measurement methods and procedures to be applied:	Measured continuously with an electricity meter.
QA/QC procedures to be applied:	The meter will be subject to regular maintenance and testing in accordance with stipulation of the meter supplier to ensure accuracy.
Any comment:	Required to estimate the emission reductions from electricity generation from LFG.

<b>Data / Parameter:</b>	<b>CEF<sub>elec,BL,y</sub></b>
Data unit:	tCO <sub>2</sub> /MWh
Description:	Carbon emission factor of electricity
Source of data to be used:	Calculated as per “Tool to calculate the emission factor for an electricity system”
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.684 Given in a paper “Study on Grid Connected Electricity Baselines in Malaysia” issued by Pusat Tenaga Malaysia. The methodology used in the paper is based on the ACM0002 “Consolidated Baseline Methodology for Grid-Connected Electricity”.
Description of measurement methods and procedures to be applied:	The CEF <sub>elec,BL,y</sub> will be calculated according to the equations from the “Tool to calculate the emission factor for an electricity system”, based on fuel consumption and electricity generation data for plants connected to the grid.
QA/QC procedures to be applied:	To be re-calculated with release of latest grid data.
Any comment:	

<b>Data / Parameter:</b>	<b>Operation of the energy plant</b>
Data unit:	Hours
Description:	Operation of the energy plant
Source of data to be used:	Project participants
Value of data applied for the purpose of calculating expected emission reductions in section B.5	-



Description of measurement methods and procedures to be applied:	On site measurement of the operating hours of the energy Data will be recorded annually.
QA/QC procedures to be applied:	The counter will be checked as per manufacturer recommendation.
Any comment:	This is monitored to ensure methane destruction is claimed for methane used in electricity plant when it is operational.

<b>Data / Parameter:</b>	<b>PE<sub>EC,y</sub></b>
Data unit:	tCO <sub>2</sub> e/yr
Description:	Project emissions from electricity consumption by the project activity during the year y
Source of data to be used:	Calculated from the electricity imported from the grid and the emission factor from the grid (EF <sub>grid,y</sub> ), according to the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”
Value of data applied for the purpose of calculating expected emission reductions in section B.5	
Description of measurement methods and procedures to be applied:	As per the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”
QA/QC procedures to be applied:	As per the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”
Any comment:	

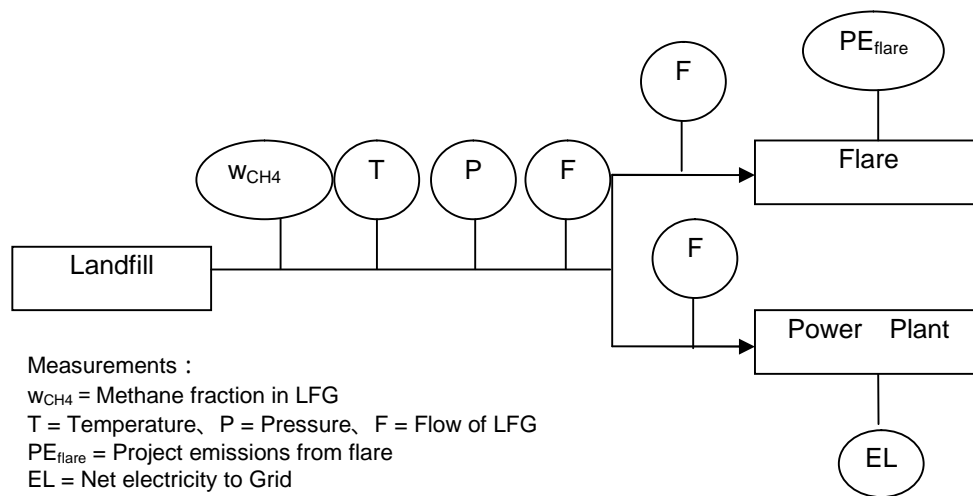
<b>Data / Parameter:</b>	<b>MG<sub>PR,y</sub></b>
Data unit:	tCH <sub>4</sub>
Description:	Amount of methane generated during year y of the project activity
Source of data to be used:	Calculated
Value of data applied for the purpose of calculating expected emission reductions in section B.5	
Description of measurement methods and procedures to be applied:	Estimated using the actual amount of waste disposed in the landfill as per the latest version of the “Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site”
QA/QC procedures to be applied:	As per the latest version of the “Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site”
Any comment:	



**B.7.2. Description of the monitoring plan:**

The monitoring plan for this project activity includes all monitoring requirements following the procedures set by ACM0001 ver.11. The monitoring will be based on direct and continuous measurement of the amount of LFG captured and destroyed at the flare platform or sent for generating electricity.

The overall monitoring plan can be illustrated in the figure below:



**Figure 4: Schematic diagram of monitoring plan**

Relevant regulations on LFG project activities shall be monitored and updated upon renewal of each crediting period. Changes to regulations will be converted to the amount of methane that would have been destroyed/ combusted during the year in the absence of the project activity ( $MD_{BL,y}$ ).

All data will be converted and stored by electronic format and cross checked with the original data. The data and calculation result will be managed by the Special Purpose Company (SPC) that will be established for project implementation. The various data and calculation results will be verified by a DOE yearly for the issuance of CER's.



	Items	Responsible Organization	Description
1	Monitoring Planning	SPC	Training will be done for the O/M team for the good understanding of the monitoring plan and the actual monitoring methods.
2	Monitoring	SPC or outsourced	All data will be stored by paper and electronic files.
3	Monitoring of Regulation	SPC or outsourced	Periodical reports will be made
4	Calibration of Monitoring Equipments	Authorized entity	Calibration record will be kept by the SPC

**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):**

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**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 2012 (1/1/2012).

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

22 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:**

1/1/2013

**C.2.1.2. Length of the first crediting period:**

7 years.

**C.2.2. Fixed crediting period:****C.2.2.1. Starting date:**

Not applicable.

**C.2.2.2. Length:**

Not applicable.

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

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;

## &lt;Construction&gt;

- 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, number of worker increase, installing of facilities, etc.
- Generation of the waste due to the construction work



## &lt;Operation&gt;

- Generation of noise and vibration due to facility operation

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;

- Efficient use of methane gas contribute to mitigation of GHG emission to the atmosphere
- LFG as renewable energy sources – cleaner fuel that replaces fossil fuel based grid power
- Diminishing of the odor problem
- Improvement of landfill's stability
- Mitigation of fire / explosions risk in the landfill

**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.

In Malaysia, environmental impact assessment is required for activities prescribed under the Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order 1987. Environmental impact assessment is required in the case of construction of new landfill site. The present project of capturing, combusting and flaring of landfill gases is not a prescribed activity and there is no need to conduct any environmental impact assessment for this project.

**SECTION E. Stakeholders' comments**

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

This project is to establish LFG recovery and power generation system on 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 combustion of LFG, 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) – NRE officers in charge mentioned that 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 competitor 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 for odor. 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:	LEE TUCK CONSTRUCTION SDN.BHD.
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Represented by:	LEE TUCK
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FAX:	+81-53-471-9373
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URL:	<a href="http://www.midac.co.jp/">http://www.midac.co.jp/</a>
Represented by:	Masahiro Doi
Title:	
Salutation:	Mr.
Last name:	Doi
Middle name:	
First name:	Masahiro



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**Annex 2**

**INFORMATION REGARDING PUBLIC FUNDING**

**NO APPLICABLE. THE PROJECT WILL BE PRIVATELY FUNDED AND WILL NOT INVOLVE ANY PUBLIC FUNDING OR OFFICIAL DEVELOPMENT ASSISTANCE (ODA).**



**Annex 3****BASELINE INFORMATION****Waste composition analysis**

Waste composition is decided based on the following analysis investigation.

**Table 5: 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	600 tons/day of waste is installed to the landfill.
Origin of waste	The waste is originated from Household, Shop, and Market, the ratio of each item is 70%, 25%, and 5%.

Based on the hearing test about recyclables and the waste type category provided by “Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site”, waste classification items are showed as follows:

**Table 6: Waste classification items**

<ul style="list-style-type: none"> <li>• Food (including Beverage and Tobacco)</li> <li>• Paper</li> <li>• Textile</li> <li>• Plastic container (transparent)</li> <li>• Plastic bag (film-like)</li> <li>• Aluminum</li> </ul>	<ul style="list-style-type: none"> <li>• Carton box</li> <li>• Disposal nappies</li> <li>• Other plastic</li> <li>• Glass</li> </ul>	<ul style="list-style-type: none"> <li>• Garden</li> <li>• Wood and Straw</li> <li>• Rigid plastic</li> <li>• Plastic container (white)</li> <li>• Steel</li> <li>• Others</li> </ul>
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This is the result of waste composition analysis.

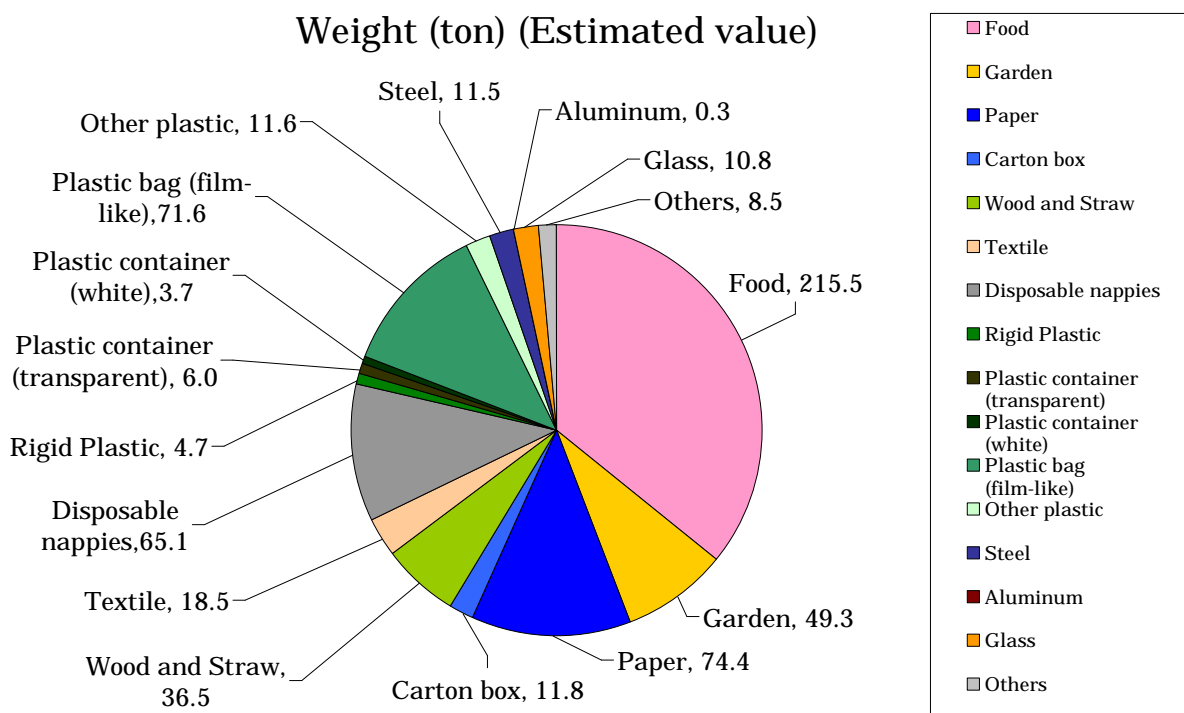


Figure 5: Result of waste composition analysis

Table 7: Result of waste composition analysis

Items	Food	Garden	Paper	Carton box	Wood and Straw	
Weight (ton) (Estimated value)	215.5	49.3	74.4	11.8	36.5	
Ratio (%)	35.9%	8.2%	12.4%	2.0%	6.1%	
Items	Textile	Disposable nappies	Rigid Plastic	Plastic container (transparent)	Plastic container (white)	Plastic bag (film-like)
Weight (ton) (Estimated value)	18.5	65.1	4.7	6.0	3.7	71.6
Ratio (%)	3.1%	10.9%	0.8%	1.0%	0.6%	11.9%
Items	Other plastic	Steel	Aluminum	Glass	Others	Total
Weight (ton) (Estimated value)	11.6	11.5	0.3	10.8	8.5	600.0
Ratio (%)	1.9%	1.9%	0.1%	1.8%	1.4%	100.0%

Classifying these items into the waste type category of “Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site”.

Table 8: Waste composition for calculation

Waste type <i>j</i>	Waste composition		$W_{j,x}$
	tons/day	%	tons/yr
Food	251.5	36%	91,798
Garden	49.3	8%	17,995
Wood and Straw	36.5	6%	13,323
Paper	86.3	14%	31,500



Textiles	18.5	3%	6,753
Others	194.0	32%	70,810

**Annex 4**

**MONITORING INFORMATION**

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