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:

The Retamim Landfill Project
Version 01
April 16, 2007

A.2. Description of the project activity:

The Retamim Landfill Project ("the Project") has been developed by the Drom Yehuda Association of Towns for Environmental Quality ("the Project Developer") in Israel ("the Host Country"). The project will collect and combust the landfill gas from the Retamim landfill.

In the past, waste from Israeli households was collected in landfill sites that were not lined and did not collect biogas produced by the landfill. These dumpsites contributed to contaminated groundwater and emissions of methane gas. The landfills were operated with minimal regulatory requirements and were often unsupervised.

For the last decade, the Israel Ministry of Environment has been leading the reform effort in the municipal sold waste (MWS) sector. The old landfills, which generate many environmental and health hazards, have been shut down and replaced with modern landfills. Some of these old landfills cause severe environmental damage due to the enormous amount of waste that has been deposited in them over several decades. Closure of old landfills will lessen their harmful environmental impacts but only rehabilitation of the sites will reduce their environmental impacts significantly. Currently, there are over a dozen landfills that have been shut down and lack the finances for rehabilitation.

The Retamim landfill operated as a legal landfill from 1975 to 2003, although data of waste dumped is limited and available only from 1978. The landfill did not have a liner or biogas collection system or a leachate drainage system throughout its operational life.

The objective of the project is to collect and flare the landfill gas from the landfill. This will involve investment in a biogas collection system and flaring equipment. The gas that will be collected may also be used to generate energy.

The main social and environmental impacts of the project will be the resulting improvements to quality of life in the area. Contaminated leachate and surface run-off from landfills can affect down-gradient ground and surface water quality, consequently affecting the local environment. The uncontrolled release of landfill gas can also negatively impact the health of the local population and lead to potential explosions at the landfill site, creating a local hazard and adding to regional air pollution.

The Israeli government is committed to the principles of sustainable development. The project assists the host country to fulfil its goals of promoting sustainable development:

1. Environment: The project improves the local environment by reducing odours, improving surface and groundwater quality and reducing uncontrolled emissions of methane.

2. Social: The project will reduce health risks to nearby populations and provide them with a rehabilitated site.

3. Economic: The project will provide a certain number of temporary positions for the landfill's rehabilitation and a certain number of permanent positions to manage the landfill gas-collection and flaring. Additionally, the project avoids uncontrolled waste management.

A.3. Project participants:

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Name of Party Involved [(Host) indicates 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
Israel (Host)	Public entity: Drom Yehuda Association of Towns for Environmental Quality	No
	Private entity: EcoTraders Ltd.	No

Further contact information for project participants is provided in Annex I.

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

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A.4.1.1. Host Party(ies):

Israel (Host Country).

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

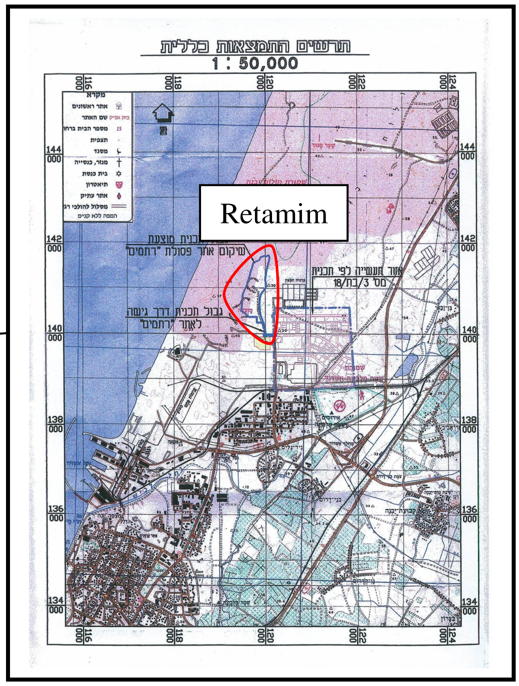
Hevel Yavne

A.4.1.3. City/Town/Community etc:

North of Ashdod

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

>> *[Please fill in the field and do not exceed one page.]*



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

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According to Annex A of the Kyoto Protocol the project falls under Sectoral Scope 13, Waste Handling and Disposal.

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

The project includes the installation of a gas collection system that will include but is not limited to the following:

- Gas extraction wells;
- Condensate extraction and storage systems;
- Flare.

In the future, the landfill gas may be used by nearby industrial installations to supply energy. In this case, the gas will be destroyed using technology other than the flare.

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

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Year	Annual estimation of emission reductions in

	tonnes of CO_2e
2008	49,279
2009	48,266
2010	47,273
2011	46,300
2012	45,346
2013	44,411
2014	43,494
Total estimated reductions (tonnes of CO_2e)	324,370
Total number of crediting years	7
Annual average over the crediting period of estimated reductions (tonnes of CO_2e)	46,339

A.4.5. Public funding of the project activity:

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There will be no public funding available for this project.

SECTION B. Application of a baseline methodology

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

The project uses the approved consolidated methodology ACM0001, "Consolidated baseline methodology for landfill gas project activities," Version 5.

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

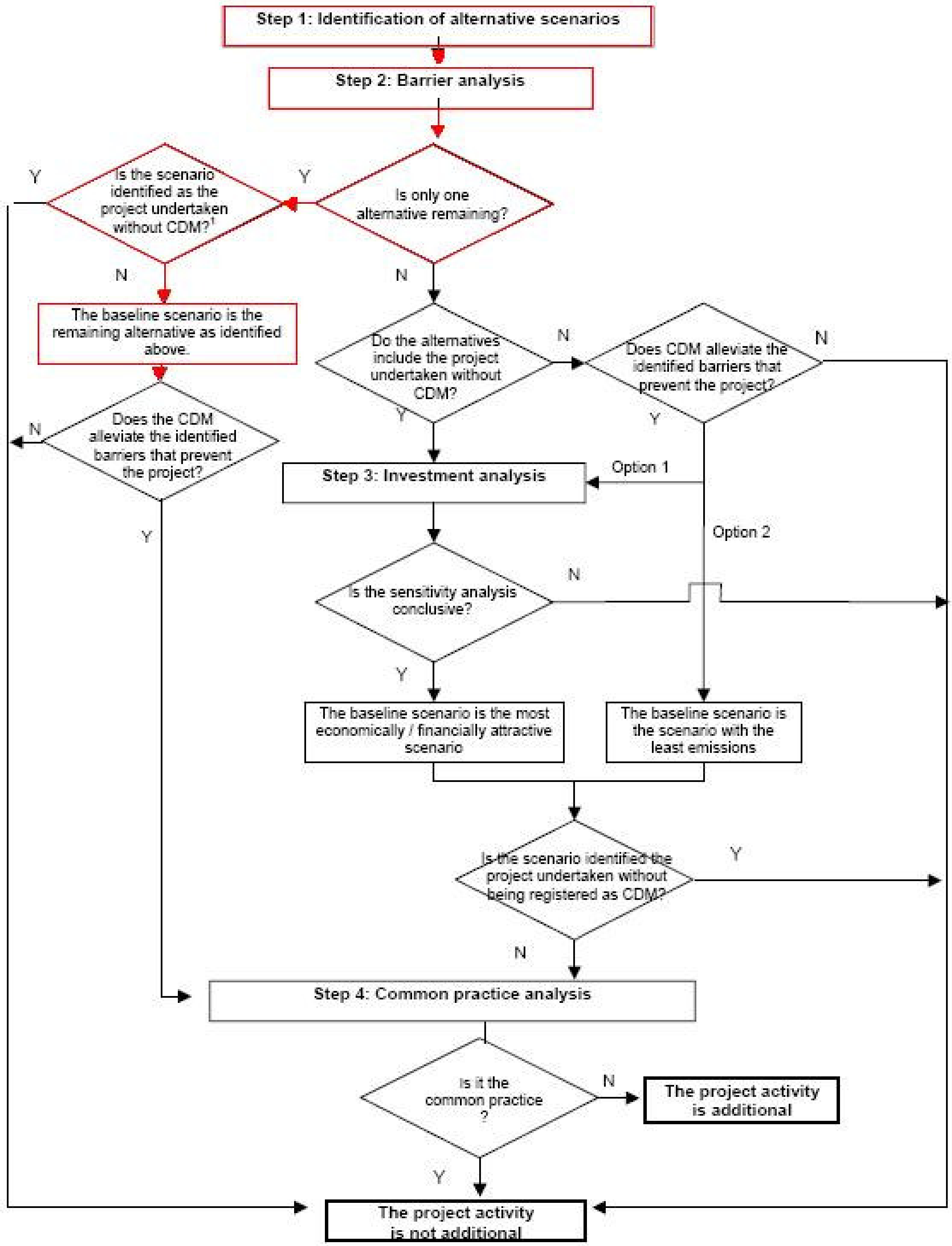
Applicability Clause	Applicability of the clause to the small scale project activity
ACM0001 is applicable to the following situations: a) The captured gas is flared; or b) The captured gas is used to produce energy (e.g. electricity/thermal energy), but no emission reductions are claimed for displacing or avoiding energy from other sources; or c) The captured gas is used to produce energy (e.g. electricity/thermal energy), and emission reductions are claimed for displacing or avoiding energy generation from other sources. In this case a baseline methodology for electricity and/or thermal energy displaced shall be provided or an approved one used, including the ACM0002. If capacity of electricity generated is less than 15MW…54 TJ, small-scale methodologies can be used.	✓ Currently, the project corresponds to situation (a). In the future, biogas may be utilised to generate electric or thermal energy and in this case, situations (b) or (c) will be applicable. Both scenarios are applicable to ACM0001. Since there are no regulatory requirements for landfill gas flaring or use at present, the baseline scenario is the total atmospheric release of landfill gas. The project activity will extract, collect and destroy landfill gas and result in greenhouse gas (GHG) reductions.

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

	Source	Gas	Included?	Justification / Explanation
Baseline	Landfill	CO_2	No.	No electricity currently used at the landfill.
		CH_4	Yes.	Freely emitted methane from landfill.
Project Activity	Landfill	CO_2	Yes	Net amount of electricity used by the project for operation of pumps and flares, using the carbon emissions factor for the Israeli electricity grid.
		CH_4	No	All methane flared and combusted. Flare efficiency entered into calculations.

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

Following the steps laid out in the "Combined tool to identify the baseline scenario and demonstrate additionality" (Version 2), here are options for the baseline scenario:



<u>Step 1a: Define alternatives that are scenarios to the proposed CDM project activity.</u>

a) The project activity (i.e. landfill gas capture and flaring with energy generation) without CDM registration;
b) Business-as-usual (i.e., no gas collection and flaring);

Sub-step 1b: Enforcement of applicable laws and regulations.
There are no regulatory requirements for closed landfills in Israel to capture and flare their landfill gas emissions. There is only a recommendation that the surface of the landfill contain less than 5 percent landfill gas content. There is nothing to compel a landfill operator to install a landfill gas capture and flaring system at the project location. Therefore, options (a) and (b) meet the applicable regulations of the State of Israel.

Sub-step 2a. Identify barriers that would prevent the implementation of alternatives:
The main barrier to the scenarios listed above is "Prevailing Practice Barriers". There has been no development of landfill gas projects in closed landfills in the Host Country, with the exception of the Hiriya CDM project. Although regulation now requires flaring landfill gas from operating landfills, closed landfills have no legal obligation to process their landfill gas emissions. Furthermore, although the Israel Electricity Authority approved an environmental premium for renewable energy to make renewable energy generation financially viable, this is a "National and/or sectoral policies or regulations under paragraph 6 (b) that have been implemented since the adoption by the COP of the CDM M&P (decision 17/CP.7, 11 November 2001)" (EB22 decision), thus disallowing its inclusion in the development of the baseline scenario. Due to municipalities' lack of resources, the common practice is to not build any type of collection or flaring system.

Because it is not the prevailing practice in Israel to capture and combust landfill gas, option (a) can be eliminated.

Sub-step 2b. Elimination of alternative scenarios prevented by barriers.
a) ~~The project activity without CDM registration (i.e. landfill gas capture and flaring with energy generation);~~
b) **Business-as-usual (i.e., no gas collection and flaring).**

Therefore, we eliminate scenario (a) and are left with the baseline scenario as (b), which is the business-as-usual scenario at the landfill site of allowing the landfill gases to be freely emitted to the atmosphere.

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 methodology ACM0001 requires that project additionality be demonstrated using the latest version of the "Tool for the demonstration and assessment of addtionality."

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

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

Alternative 1: The project activity (i.e. landfill gas capture and flaring with energy generation) without CDM registration;
Alternative 2: Business-as-usual (i.e., no gas collection and flaring).

Sub-step 1b. Consistent with mandatory laws and regulations.

The landfill complies with the national regulations with regards to the closure and rehabilitation of landfills. Under these regulations, the methane concentration on the landfill surface is recommended to be kept below 5% but this is not a mandatory regulation, only a recommendation. Therefore, as the national regulations stand, flaring is not required at the project site (i.e., solutions such as venting could be adopted). The project developer understands that no LFG would have been flared in the absence of the project activity.

All alternatives comply with the laws and regulatory requirements at the project location.

Step 2. Investment Analysis

Sub-step 2a*. Determine appropriate analysis method*
The project may generate revenues from the sale of energy. Therefore, Option III, "Benchmark Analysis" will be used below.

Sub-step 2b. – Option III. Benchmark analysis
The likelihood of development of this project as opposed to the continuation of current practice (i.e., no collection and combustion of landfill gas) is determined by calculating the project's IRR and comparing this with the benchmark of interest rates available to a local investor and with the interest rates to which an investor would be subject if requiring funding for the project. The project activity presents a risk to any investor, whether the project owner (a municipality) or an external body that decides to invest in the project. The main risk is the amount of gas available from the landfill, which imperils the potential for energy generation. Therefore, a benchmark for comparison with the financial attractiveness of the project activity is a similar example of risky investment. A medium-risk option for investment, a weighted average return from 30 percent T-bill and 70 percent from the Tel Aviv Stock Exchange 100 Index (March 2006-March 2007) provided a 11.59 percent return.[1]

Sub-step 2c: Calculation and comparison of financial indicators
The Table below shows the IRR for the project activity, which was calculated using:

1. Financial information provided by the project owner and expert parties[2];
2. An annual interest rate that would be paid to cover any negative cash flows incurred during the life of the investment at the rate of 8.1%, the 2006 bank credit rate[3]; and
3. The interest rate that would be earned on the returns on investment during the investment's duration, a rate of 4.375% that is the average rate of an Israeli T-bill.

As shown, the project IRR (without carbon revenues) is lower than the medium-risk weighted average interest rate, as well as the bank credit rate.

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[1] T-bill rates of return on investment taken from the Tel Aviv Stock Exchange website, accessed March 5, 2007. (http://www.tase.co.il/TASEEng/Products/T-bills/Market+Data/). The 1-year return in the TA 100 Index taken from Bizportal, accessed March 5, 2007. (http://www.bizportal.co.il/shukhahon/bizmadad.shtml?Opt=1&p_id=199) This site only is available in Hebrew. Returns on the Tel Aviv 100 Index for 2006 are shown in green at 14.68%.

[2] Receipts from the Drom Yehuda Association of Towns for Environmental Quality; data provided by Gal Handasa and Citrine.

[3] Lending rate "Bank credit" from the Bank of Israel website: http://www.bankisrael.gov.il/deptdata/mehkar/indic/eng_a6.htm.

Table 1: Financial results of the project activity

	Activity without CDM revenues	Benchmark: 30% T-bill, 70% TA-100 Index [Medium risk]
IRR	0.81%	11.59
NPV (NIS)	₪-2,900,443.75	
NPV (USD)	-$690,581.84	

The electricity price is assumed to be 0.2866 New Israeli Shekel (NIS) (approximately 7¢ US) per kWh, consistent with current prices averaged over the base and peak period prices, which are not expected to change substantially.

Sub-step 2d: Sensitivity Analysis
A sensitivity analysis was conducted by altering the following parameters:

- Reduction in project Operational and Maintenance costs;
- Increase in project Operational and Maintenance costs; and
- Increase in project revenues (i.e. the price of electricity increases).

Those parameters were selected as being the most likely to fluctuate over time. The financial analysis conducted above was altered by changing each of these parameters by 10%, and assessing what the impact on the project IRR would be (see table below). The project IRR either remains lower than its alternative or performs marginally better than the risk-free treasury (T-bill). The project IRR remains well below the weighted rate of return (30% T-bill, 70% Tel Aviv 100 Index).

Table 2: Sensitivity Analysis

	IRR	NPV (NIS)	NPV ($)
Project activity (No CDM)	0.81%	₪ -2,900,443.75	-$690,581.84
O&M costs decrease (-10%)	-0.85%	₪ -3,740,426.04	-$490,586.06
O&M costs increase (+10%)	2.32%	₪ -2,060,461.46	-$890,577.63
Project revenues (electricity) increase (+10%)	3.02%	₪ -1,644,363.05	-$391,515.01

In conclusion, the project IRR remains low even in the case where these parameters change in favour of the project. The sensitivity analysis IRRs are lower than the 11.59 percent weighted return to which the project was compared to above.

CDM revenues would make this project financially viable. The following table indicates the project's IRR and NPV with CDM revenue:

Table 3 Project with Carbon Revenues

	IRR	NPV (NIS)	NPV ($)
Project activity (+ CDM)	15.84%	₪9,727,763.41	$2,316,134.15
O&M costs decrease (-10%)	16.51%	₪10,567,745.71	$2,516,129.93
O&M costs increase (+10%)	11.91%	₪5,376,821.86	$1,280,195.68
Project revenues (electricity) increase (+10%)	13.91%	₪7,472,884.85	$1,779,258.30

In summary, the project cannot be considered as financially attractive without carbon revenues and we continue with the additionality assessment in Step 4, below.

Step 4. Common Practice Analysis

Sub-step 4a. Analyze other activities similar to the proposed project activity:
Closed landfills in Israel are not required to collected and treat biogas emissions. Landfills are owned by municipalities that do not have the financial resources to rehabilitate them and certainly not to voluntarily implement a biogas collection system. There are currently no closed landfills in Israel that collect and treat their gas emissions and no similar activities to the proposed project activity.

Sub-step 4b. Discussion of similar options that are occurring.
Landfill gas capture and combustion takes place in Israel only at operating landfills and are required to do so by national federal regulation. There are no closed landfills, however, where landfill gas is captured and combusted, with the exception of the Hiriya landfill, which is a CDM project.[4] There are no similar activities occurring in the Host Country that do not include a CDM component.

Therefore, due to financial and common practice barriers the Retamim Landfill project can be considered additional.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

The methodology is applied to the project activity based on scenarios (a) and (b) of ACM0001, allowing the captured gas to be flared or to be used to generate steam and thermal energy but no emission reductions will be claimed for displacing energy from other sources.

According to ACM0001, emission reductions achieved by the project in a given year "y" are estimated as follows:

Equation 1
$$ER_y = (MD_{project,y} – MD_{reg,y}) * GWP_{CH4} + EL_y * CEF_{electricity,y} – ET_y * CEF_{thermal,y}$$

Where:

ER_y	*Emission reductions (tCO_2e)*
$MD_{project,y}$	*Methane that would have been destroyed/combusted during the year (tCH_4)*
$MD_{reg,y}$	*Methane that would have been destroyed/combusted during the year in the absence of the project (tCH_4)*
GWP_{CH4}	*Global warming potential of methane (21 tCO_2e/tCH_4)*
EL_y	*Net quantity of electricity exported during year (MWh)*
$CEF_{electricity,y}$	*Carbon emission factor of electricity displaced (tCO_2e/MWh) [From ACM0002]*

[4] The Ministry of Environment's website lists four sites closed landfills that were to be rehabilitated. Of the four, only Hiriya installed a landfill collection system and flare. Of the other three sites, Kfar Saba was supposed to install a gas collection system and flare but did not; at the Netanya site the municipality chose to move the waste to another site and recycle as much as possible; and at the Tira site it was decided to vent the gas, not flare it.

ET_y	*Quantity of fossil fuel used for energy on site under project activity (TJ)*
$CEF_{thermal,y}$	*Carbon emission factory of fuel used to generate thermal/mechanical energy (tCO_2e/TJ)*

Equation 2

$EL_y = EL_{EX,LFG} - EL_{IMP}$

Where:

$EL_{EX,LFG}$	*Net quantity of electricity exported during year produced using LFG (MWh)*
EL_{IMP}	*Electricity imported for project, defined as differenced of project imports less any imports in the baseline (MWh)*

The consolidated methodology for landfill projects uses an equation for calculating the amount of methane destroyed in the baseline scenario, as opposed to the amount of methane emitted in this scenario. We will use the convention established in the consolidated methodology and use this section to describe the amount of methane destroyed in the baseline scenario. The equation is, as follows:

Equation 3

$MD_{reg,y} = MD_{project,y} * AF$

Where:

$MD_{reg,y}$	*Methane that would have been destroyed/combusted during the year "y" in the absence of the project activity (tCH_4).*
$MD_{project,y}$	*Methane actually destroyed/combusted during the year "y" (tCH_4).*
AF	*Adjustment Factor (%)*

The methane destroyed by the project was estimated using the US EPA's LandGEM model (Version 3.02) with Lo (methane generation potential) and k (methane generation rate constant) values appropriate for the Host Country and assuming a 15% uncertainty of the results and that only 50% of the landfill gas generated is collected by the gas collection system (average for landfills in developing countries). In any case, this projection is ex ante and is only an estimate. The actual amount of methane reduced will be monitored directly and the carbon emission reductions will be calculated from this data.

The Adjustment Factor (AF) value used for this project is 0%. This value is justified based on local regulations, which do not require flaring of any landfill gas in closed landfills. Although there is a recommendation to keep methane concentration in the surface of the landfill below 5%, this is not mandatory and does not require flaring (i.e. solutions such as venting could be adopted). The project developer therefore understands that no LFG would have been flared in the absence of the project activity.

$MD_{project}$ will be determined ex post by metering the actual quantity of methane captured and destroyed once the project activity is operational. The project, in the future, may use the LFG to generate electric or thermal energy and all LFG sent to a generator or boiler will be metered and monitored.

Equation 4

$MD_{project} = MD_{flared,y} + MD_{electricity,y} + MD_{thermal,y}$

Where:

$MD_{flared,y}$	*Methane destroyed in the flare (tCH_4).*

$MD_{electricity,y}$	*Methane destroyed in the production of electric energy (tCH_4).*
$MD_{thermal,y}$	*Methane destroyed in the production of thermal energy (tCH_4).*

<u>Equation 5</u>

$MD_{flared,y} = (LFG_{flare,y} * w_{CH4,y} * D_{CH4}) - (PE_{flare,y} / GWP_{CH4})$

Where:

$LFG_{flare,y}$	*Quantity of landfill gas fed for the generation of thermal energy measured in cubic meters (m^3).*
$w_{CH4,y}$	*Average methane fraction of the landfill gas as measured during the year and expressed as a fraction (in m^3 CH_4 / m^3 LFG).*
D_{CH4}	*Methane density expressed in tonnes of methane per cubic meter of methane (tCH_4/m^3CH_4)*
$PE_{flare,y}$	*Project emissions from flaring the LFG in year y (tCO_2e)*

<u>Equation 6</u>

$MD_{electricity} = LFG_{electricity,y} * w_{CH4,y} * D_{CH4}$

Where:

$LFG_{electricity,y}$	*Quantity of landfill gas fed for the generation of electricity measured in cubic meters (m^3).*
$w_{CH4,y}$	*Average methane fraction of the landfill gas as measured during the year and expressed as a fraction (in m^3 CH_4 / m^3 LFG).*
D_{CH4}	*Methane density expressed in tonnes of methane per cubic meter of methane (tCH_4/m^3CH_4)*

<u>Equation 7</u>

$LFG_{total,y} = LFG_{electricity} + LFG_{flare} + LFG_{thermal}$

<u>Equation 8</u>

$MD_{total,y} = LFG_{total,y} * W_{CH4,y} * D_{CH4}$

The following table provides the key information and data used to determine the baseline scenario:

Table 4. Data used to determine the baseline scenario

	Variable	Unit	Data Source
1.	Total amount of landfill gas captured	m^3	Project developer
2.	Amount of landfill gas flared	m^3	Project developer
3.	*Optional Scenario*: Amount of landfill gas combusted in boilers	m^3	Project developer
4.	*Optional Scenario*: Amount of landfill gas combusted in generator		Project developer
5.	Flare combustion efficiency, determined by adherence to manufacturer's specifications for flare temperature (1) and the minimum LFG flow (2)	%	Project developer
6.	Methane fraction in the landfill gas	%	Project developer
7.	Temperature of the landfill gas	°C	Project developer

8.	Pressure of the landfill gas	pa	Project developer
9.	Regulatory requirements relating to landfill gas projects	text	Host country legislation

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

Data / Parameter:	GWP_{CH4}
Data unit:	tCO_2e/tCH_4
Description:	*Global warming potential of methane*
Source of data used:	UNFCCC
Value applied:	21
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	Variable's value will be confirmed at the beginning of each crediting period.

Data / Parameter:	MD_{reg}
Data unit:	tCH_4
Description:	Methane that would have been destroyed/combusted during the year in the absence of the project
Source of data used:	Ministry of Environmental Protection
Value applied:	0
Justification of the choice of data or description of measurement methods and procedures actually applied :	At old landfills in Israel, there is no legal requirement for landfill gas to be destroyed. There is a recommendation that gas should be vented if methane concentrations reached certain levels.
Any comment:	

Data / Parameter:	AF
Data unit:	%
Description:	Adjustment factor
Source of data used:	Project developer
Value applied:	0
Justification of the choice of data or description of measurement methods and procedures actually applied :	The Adjustment Factor (AF) value used for this project is 0%. This value is justified based on local regulations, which do not require flaring of any landfill gas in closed landfills. Although there is a recommendation to keep methane concentration in the surface of the landfill below 5%, this is not mandatory and does not require flaring (i.e. solutions such as venting could be adopted). The project developer therefore understands that no LFG would have been flared in the absence of the project activity.
Any comment:	

B.6.3 Ex-ante calculation of emission reductions:

Ex ante emission reductions are based on landfill gas availability derived from the LandGEM model. When the LandGEM results are used, the follow ex ante calculations are possible:

Equation 1

$ER_y = (MD_{project,y} – MD_{reg,y}) * GWP_{CH4} + EL_y * CEF_{electricity,y} - ET_y * CEF_{thermal,y}$ [tCO2e]

	2008	2009	2010	2011	2012	2013	2014
$MD_{project}$ [tCH_4]	2,207	2,159	2,111	2,065	2,019	1,975	1,931
AF [%]	0%	0%	0%	0%	0%	0%	0%
MD_{reg} [tCH_4]	0	0	0	0	0	0	0
GWP_{CH4} [tCO_2e/tCH_4]	21	21	21	21	21	21	21
EL_y [MWh]	8277	8277	8277	8277	8277	8277	8277
$CEF_{electricity,y}$ [tCO_2/MWh]	0.937	0.937	0.937	0.937	0.937	0.937	0.937
ETy [TJ/yr]	0	0	0	0	0	0	0
$CEF_{thermal,y}$ [tCO2e/TJ]	0	0	0	0	0	0	0
ER_y	**54,096**	**53,083**	**52,090**	**51,116**	**50,162**	**49,227**	**48,311**

Equation 2

$EL_y = EL_{EX,LFG} - EL_{IMP}$

	2008	2009	2010	2011	2012	2013	2014
EL ex,lfg (MW)	8,322.0	8,322.0	8,322.0	8,322.0	8,322.0	8,322.0	8,322.0
EL imp (MWh)	44.64	44.64	44.64	44.64	44.64	44.64	44.64
ELy [MWh]	**8,277**	**8,277**	**8,277**	**8,277**	**8,277**	**8,277**	**8,277**

Equation 3

$MD_{reg,y} = MD_{project,y}*AF$

	2008	2009	2010	2011	2012	2013	2014
$MD_{project}$ [tCH_4]	2,207	2,159	2,111	2,065	2,019	1,975	1,931
AF	0	0	0	0	0	0	0
$MD_{reg,y}$	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Equation 4

$MD_{project} = MD_{flared,y} + MD_{electricity,y} + MD_{thermal,y}$

	2008	2009	2010	2011	2012	2013	2014
$MD_{flared,y}$	865	816	769	723	677	633	589
$MD_{electricity,y}$	1,342	1,342	1,342	1,342	1,342	1,342	1,342
$MD_{thermal,y}$	0	0	0	0	0	0	0
$MD_{project}$	**2,207**	**2,159**	**2,111**	**2,065**	**2,019**	**1,975**	**1,931**

Equation 5

$MD_{flared,y} = (LFG_{flare,y} * w_{CH4,y} * D_{CH4}) - (PE_{flare,y} / GWP_{CH4})$ [tCH4/yr]

	2008	2009	2010	2011	2012	2013	2014
$LFG_{flare,y}$ [m3/yr]	3,052,310	2,917,716	2,785,787	2,656,471	2,529,716	2,405,470	2,283,684
$MD_{thermal,y}$ [MWh]	0	0	0	0	0	0	0
$W_{CH4,y}$ [m^3CH_4/m^3LFG]	50%	50%	50%	50%	50%	50%	50%
D_{CH4} [tCH_4/m^3CH_4]	7.168E-04	7.168E-04	7.168E-04	7.168E-04	7.168E-04	7.168E-04	7.168E-04
$PE_{flare,y}$	4,816	4,816	4,816	4,816	4,816	4,816	4,816
$MD_{flared,y}$	**865**	**816**	**769**	**723**	**677**	**633**	**589**

Equation 6

$MD_{electricity}=LFG_{electricity,y} * w_{CH4,y} * D_{CH4}$

	2008	2009	2010	2011	2012	2013	2014
$LFG_{electricity,y}$ [m^3 LFG]	3,744,900	3,744,900	3,744,900	3,744,900	3,744,900	3,744,900	3,744,900
$W_{CH4,y}$ [m^3CH_4/m^3LFG]	50%	50%	50%	50%	50%	50%	50%
D_{CH4} [tCH_4/m^3CH_4]	7.168E-04	7.168E-04	7.168E-04	7.168E-04	7.168E-04	7.168E-04	7.168E-04
$MD_{electricity,y}$	**1,342**	**1,342**	**1,342**	**1,342**	**1,342**	**1,342**	**1,342**

Tool to determine project emissions from flaring gases containing methane (PEflare,y)

STEP 1 - Determination of mass flow rate of residual gas that is flared

$FM_{RG,h} = \rho_{RG,n,h} * FV_{RG,h}$ [kg/h]

$\rho_{RG,n,h}$ [kg/m3]	0.983
$FV_{RG,h}$ [m3/h]	731
$FM_{RG,h} = \rho_{RG,n,h} * FV_{RG,h}$ [kg/h]	**718.85**

P_n [Pa]	101,325
R_u (Pa.m3/kmol.K)	8314
$MM_{RG,h}$ [kg/kmol]	22.03
T_n (K)	273.15
$\rho_{RG,n,h}$ [kg/m3]	0.983

$fv_{CH4,h}$	50%
$fv_{CH4,h}$	50%
MM_{CH4} (kg/mol)	16.04
MM_{N2} (kg/mol)	28.02
$MM_{RG,h}$ [kg/kmol]	22.03

STEP 2 - Determination of the mass fraction of C, H, O2 and N2 in residual gas

$fv_{i,h\ [CH4]}$	0.5
$fv_{i,h\ [N2]}$	0.5
$AM_{j\ [C]}$ [kg/kmol]	12
$AM_{j\ [H]}$ [kg/kmol]	1.01
$AM_{j\ [N]}$ [kg/kmol]	14.01
$NA_{j,i\ [C]}$	1
$NA_{j,i\ [H]}$	4

$NA_{j,i\ [N]}$	2
$MM_{RG,h}$ [kg/kmol]	22.03
$fm_{j,h\ [C]} = (\Sigma fv_{i,h} * AM_j * NA_{j,i})/MM_{RG,h}$	0.272
$fm_{j,h\ [H]} = (\Sigma fv_{i,h} * AM_j * NA_{j,i})/MM_{RG,h}$	0.092
$fm_{j,h\ [N]} = (\Sigma fv_{i,h} * AM_j * NA_{j,i})/MM_{RG,h}$	0.636

STEP 3 Left out, will not monitor flare emissions.
STEP 4 Left out, will not monitor flare emissions.

STEP 5 - Determination of methane mass flow rate of residual gas on a dry basis

$FV_{RG,h}$ [m3/h]	731
$fv_{CH4,RG,h}$	0.5
$\rho_{CH4,n}$ [kg/m3]	0.716
$TM_{RG,h}$ [kg/h]	**261.82**

STEP 6 - Determination of the hourly flare efficiency

$\eta_{flare,h}$	**0.9**

STEP 7 - Calculation of annual project emissions from flaring based on measured hourly values or based on default flare efficiencies

$TM_{RG,h}$ [kg/h]	261.82
$\eta_{flare,h}$	0.9
GWP_{CH4} [$tCO_2e/tCH4$]	21
$PE_{flare,y}$ [tCO_2e/yr]	**4,816**

Equation 7

$LFG_{total,y} = LFG_{electricity} + LFG_{flare} + LFG_{thermal}$

	2008	2009	2010	2011	2012	2013	2014
$LFG_{electricity,y}$	3,744,900	3,744,900	3,744,900	3,744,900	3,744,900	3,744,900	3,744,900
$LFG_{flare,y}$	3,052,310	2,917,716	2,785,787	2,656,471	2,529,716	2,405,470	2,283,684
$LFG_{thermal,}$	0	0	0	0	0	0	0
$LFG_{total,y}$ [m3 LFG/yr]	**6,797,210**	**6,662,616**	**6,530,687**	**6,401,371**	**6,274,616**	**6,150,370**	**6,028,584**

Equation 8

$MD_{total,y} = LFG_{total,y} * W_{CH4,y} * D_{CH4}$

	2008	2009	2010	2011	2012	2013	2014
$LFG_{total,y}$ [m3 LFG/yr]	6,797,210	6,662,616	6,530,687	6,401,371	6,274,616	6,150,370	6,028,584
$W_{CH4,y}$	50%	50%	50%	50%	50%	50%	50%

[m^3CH_4/m^3LFG]							
D_{CH4} [tCH_4/m^3CH_4]	7.168E-04	7.168E-04	7.168E-04	7.168E-04	7.168E-04	7.168E-04	7.168E-04
$MD_{total,y}$ [MWh]	**2,436**	**2,388**	**2,341**	**2,294**	**2,249**	**2,204**	**2,161**

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

Year	Estimation of project activity emissions	Estimation of baseline emissions (tonnes of CO_2e)	Estimation of leakage (tonnes of CO_2e)	Estimation of overall emission reductions
2008	4,816	54,096	n/a	49,279
2009	4,816	53,083	n/a	48,266
2010	4,816	52,090	n/a	47,273
2011	4,816	51,116	n/a	46,300
2012	4,816	50,162	n/a	45,346
2013	4,816	49,227	n/a	44,411
2014	4,816	48,311	n/a	43,494
Total Emission Reductions (tCO2e)				316,120

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

B.7.1 Data and parameters monitored:

Data / Parameter:	$LFG_{total,y}$
Data unit:	m^3
Description:	Total amount of landfill gas captured
Source of data to be used:	Flow meter – project developer
Value of data applied for the purpose of calculating expected emission reductions in section B.5	2008: 6,797,210 2009: 6,662,616 2010: 6,530,687 2011: 6,401,371 2012: 6,274,616 2013: 6,150,370 2014: 6,028,584
Description of measurement methods and procedures to be applied:	The data will be continuously measured by a flow meter, which will be calibrated and maintained according to the manufacturer's specifications. Errors probability will be ensured to be less than 5%. Data to be aggregated monthly and yearly.
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	$LFG_{flare,y}$
Data unit:	m^3
Description:	Total amount of landfill gas captured
Source of data to be used:	Flow meter – project developer

Value of data applied for the purpose of calculating expected emission reductions in section B.5	2008 3,052,310 2009 2,917,716 2010 2,785,787 2011 2,656,471 2012 2,529,716 2013 2,405,470 2014 2,283,684
Description of measurement methods and procedures to be applied:	The data will be continuously measured by a flow meter, which will be calibrated and maintained according to the manufacturer's specifications. Errors probability will be ensured to be less than 5%. Data to be aggregated monthly and yearly.
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	$LFG_{electricity,y}$
Data unit:	m^3
Description:	Total amount of landfill gas captured
Source of data to be used:	Flow meter – project developer
Value of data applied for the purpose of calculating expected emission reductions in section B.5	2008 3,744,900 2009 3,744,900 2010 3,744,900 2011 3,744,900 2012 3,744,900 2013 3,744,900 2014 3,744,900
Description of measurement methods and procedures to be applied:	The data will be continuously measured by a flow meter, which will be calibrated and maintained according to the manufacturer's specifications. Errors probability will be ensured to be less than 5%. Data to be aggregated monthly and yearly.
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	$LFG_{thermal,y}$
Data unit:	m^3
Description:	Total amount of landfill gas captured
Source of data to be used:	Flow meter – project developer
Value of data applied for the purpose of calculating expected emission reductions in section B.5	2008 0 2009 0 2010 0 2011 0 2012 0 2013 0 2014 0
Description of measurement methods and procedures to be	The data will be continuously measured by a flow meter, which will be calibrated and maintained according to the manufacturer's specifications. Errors probability will be ensured to be less than 5%. Data to be aggregated monthly and yearly.

applied:	
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	$PE_{flare,y}$
Data unit:	tCO_2e
Description:	Project emissions from flaring the landfill gas in year y
Source of data to be used:	Metering of manufacturer's specifications – project developer
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.9
Description of measurement methods and procedures to be applied:	The flare's temperature and flow rate of gas will be monitored continuously to ensure compliance with manufacturer's specifications. Metering devices will be maintained and calibrated according to the manufacturer's specifications.
QA/QC procedures to be applied:	If in any hour the temperature and gas flow rate are outside of the flare manufacturer's specifications, a 50% efficiency value will be used for this hour.
Any comment:	

Data / Parameter:	$w_{CH4,y}$
Data unit:	m^3 CH_4/ m^3 LFG
Description:	Methane fraction of LFG
Source of data to be used:	Gas quality analyser – project developer
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:	Will be measured by continuously gas quality analyzer. The gas analyzer will be subject to maintenance and testing to ensure accuracy, to be performed according to the manufacturer's specifications.
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	T
Data unit:	^oC
Description:	Temperature of the landfill gas
Source of data to be used:	Meter – Project Developer.
Value of data applied for the purpose of	N/a

calculating expected emission reductions in section B.5	
Description of measurement methods and procedures to be applied:	Meter will automatically measure temperature and pressure.
QA/QC procedures to be applied:	Measured to determine the density of methane D_{CH4}. No separate monitoring of temperature is necessary when using flow meters that automatically measure temperature and pressure, expression LFG volumes in normalized cubic meters. The temperature meter will be maintained periodically according to the manufacturer's specifications.
Any comment:	

Data / Parameter:	p
Data unit:	Pa
Description:	Landfill gas pressure
Source of data to be used:	Meter – Project Developer.
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:	Meter will automatically measure temperature and pressure.
QA/QC procedures to be applied:	Measured to determine the density of methane D_{CH4}. No separate monitoring of temperature is necessary when using flow meters that automatically measure temperature and pressure, expression LFG volumes in normalized cubic meters. The temperature meter will be maintained periodically according to the manufacturer's specifications.
Any comment:	

Data / Parameter:	$EL_{EX,LFG}$
Data unit:	MWh
Description:	Amount of electricity exported from the project
Source of data to be used:	Meter located at the project site.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	8,322
Description of measurement methods and procedures to be	Measured continuously by the project developer. Required to estimate the emission reductions from electricity generation from LFG, if credits are claimed.

applied:	
QA/QC procedures to be applied:	Meter will be maintained calibrated according to the manufacturer's specifications.
Any comment:	

Data / Parameter:	EL_{IMP}
Data unit:	MWh
Description:	Electricity imported to meet project requirements
Source of data to be used:	Meter located at the project site.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	44.64
Description of measurement methods and procedures to be applied:	Measured continuously by the project developer.
QA/QC procedures to be applied:	Meter will be maintained calibrated according to the manufacturer's specifications.
Any comment:	

Data / Parameter:	$CEF_{electricity,y}$
Data unit:	tCO_2/MWh
Description:	Carbon emission factor of the electricity grid.
Source of data to be used:	Israel Electric Company and ACM0002.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.937
Description of measurement methods and procedures to be applied:	Yearly calculation by the project developer. The margin is to be calculated annually ex-post by the project developer following directions of methodology ACM0001.
QA/QC procedures to be applied:	Required to determine CO2 emissions from use (or supply) of electricity or other energy carriers to operate the project activity.
Any comment:	

Data / Parameter:	ET_y
Data unit:	TJ
Description:	Thermal energy used at the landfill during the project
Source of data to be used:	Fuel purchase receipts.
Value of data applied	N/a

for the purpose of calculating expected emission reductions in section B.5	
Description of measurement methods and procedures to be applied:	N/a
QA/QC procedures to be applied:	N/a
Any comment:	

Data / Parameter:	$CEF_{thermal}$
Data unit:	tCO_2/TJ
Description:	Carbon emission factory of the thermal energy
Source of data to be used:	IPCC 2006
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:	
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	Regulatory requirement relating to landfills
Data unit:	
Description:	
Source of data to be used:	
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:	Recorded annually to change the adjustment factory (AF) or $MD_{reg,y}$.
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	Operation of energy plant
Data unit:	Hours
Description:	
Source of data to be used:	Project developer
Value of data applied for the purpose of calculating expected emission reductions in section B.5	8,322
Description of measurement methods and procedures to be applied:	Operating hours will be recorded annually.
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	Operation of the boiler
Data unit:	Hours
Description:	
Source of data to be used:	Factory/Project developer
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:	Recorded annually
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	$fv_{i,h}$
Data unit:	
Description:	Volumetric fraction of component I in the gas in hour h where I = CH_4, CO, CO_2, O_2, H_2, N_2
Source of data to be used:	Measurements by project using a continuous gas analyser
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.5 CH_4 0.5 N_2
Description of	Fraction of methane in the biogas will be monitored continuously, using a gas

measurement methods and procedures to be applied:	analyser. The rest of the gas will be assumed to be N_2.
QA/QC procedures to be applied:	Analysers will be periodically calibrated according to the manufacturer's recommendation.
Any comment:	

Data / Parameter:	$FV_{RG,h}$
Data unit:	m^3/h
Description:	Volumetric flow rate of the residual gas in dry basis at normal conditions in the hour *h*
Source of data to be used:	Measurements by project participants using a flow meter
Value of data applied for the purpose of calculating expected emission reductions in section B.5	731
Description of measurement methods and procedures to be applied:	The volumetric flow rate of the landfill gas will be measured continuously. Values to be averaged hourly or at a shorter time interval.
QA/QC procedures to be applied:	Flow meters are to be periodically calibrated according to the manufacturer's recommendation.
Any comment:	

Data / Parameter:	T_{flare}
Data unit:	°C
Description:	Flare temperature
Source of data to be used:	Measurements by project participants
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Flare assumed to be operating within the specifications of the manufacturer.
Description of measurement methods and procedures to be applied:	The temperature of the flare will be measured to ensure that it remains within the parameters set by the manufacturer, as required by the Tool to determine project emissions from flaring gases containing methane.
QA/QC procedures to be applied:	Equipment to measure flare temperature will be maintained and calibrated according to the manufacturer's instructions and replaced as needed.
Any comment:	

Data / Parameter:	Other flare operation parameters
Data unit:	
Description:	Include all data and parameters that are required to monitor whether the flare

	operates within the range of operating conditions according to the manufacturer's specifications.
Source of data to be used:	Measurements by 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:	Measured continuously in order to make use of default flare efficiency values.
QA/QC procedures to be applied:	
Any comment:	

B.7.2 Description of the monitoring plan:

The project monitoring will be undertaken by the designated engineer on-site and/or other authorised individuals. The project's monitoring plan will follow international standards and will include (but is not limited to) data monitoring, regular equipment maintenance and calibrations, data verification and troubleshooting measures.

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)

The baseline study was completed by Ms. Edith Molot, EcoTraders, on March 8, 2007. Contact information may be found in Annex I.

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:

January 1, 2008

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

More than twenty 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:

01/01/2008

C.2.1.2. Length of the first crediting period:

7 years.

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

C.2.2.2. Length:

SECTION D. Environmental impacts

>>

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

No environmental analysis for the project was required. However, by collecting and combusting the landfill gas released by the Retamim landfill, the project activity will reduce the global and local environmental impacts of uncontrolled landfill gas emissions. The major components of landfill gas, methane and carbon dioxide, are colourless and odourless. Although the majority of landfill gas emissions are quickly diluted in the atmosphere, in confined spaces there may be a risk of asphyxiation and/or toxic effects if the landfill gas in present in high concentrations.

The primary global environmental problem caused by these gases is that they are greenhouse gases that contribute to climate change, as identified in the United Nations Framework Convention on Climate Change. Landfill gas also contains over 150 trace components that can cause other local and global environmental effects such as odour nuisances, stratospheric ozone layer depletion and tropospheric ozone creation.

The local environmental impacts of uncontrolled released of landfill gases include the risks of fire and/or explosions, landfill gas migration, dust, odours, vermin, unsightliness and litter, each of which may occur on- or off-site.

When landfill gas is collected and flared, operational practices at the landfill are improved, which contributes to sustainable development. Sustainable development in the area of landfills means accelerating waste stabilization such that the landfill processes can be said to be largely complete within one generation (30 – 50 years). This ensures that both leachate and methane are more carefully managed and controlled and the degradation processes are accelerated. Through the construction of landfill gas collection and flaring systems in closed landfills, such as in the project activity, a contribution it made to sustainability through the promotion of best practices to improve landfill management standards.

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:

Environmental impacts of the project are only positive, given that the project will reduce methane emissions and provide a source of renewable energy. Therefore, no environmental impact assessment is required.

SECTION E. Stakeholders' comments

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

A stakeholders' meeting was held on February 15, 2007 in Yavne at the offices of the Drom Yehuda Association of Towns for Environmental Quality. Approximately twenty-five people attended, primarily representatives of local communities and public sector staff responsible for environmental issues.

The meeting consisted of three presentations, which were followed by a questions and comments by the stakeholders. Mr. Yitzchak Kugman opened the event by welcoming everyone and introducing the Drom Yehuda Association of Towns for Environmental Quality, its mandate and its involvement with the Retamim landfill. He was followed by Mr. Giora Lieberman, the Association's engineer, who provided a description of the landfill site, a description of the site's rehabilitation and a description of the project. The final presentation, by EcoTraders Ltd, explained climate change, the Kyoto Protocol, the CDM, the importance of stakeholders' contributions and the how the CDM will contribute to project activity's success.

Stakeholders were invited to visit the EcoTraders website and send further comments or questions via the website.

Photographs from the stakeholders' meeting for the Retamim landfill.

E.2. Summary of the comments received:

Q1: What will happen to CERs generated by the project activity if Israel accepts an emission reduction target starting in 2013?

Q2: Doesn't the combustion of methane produce CO_2 emissions?

Q3: Who will be responsible for actually building and undertaking the project activity?

Q4: Can a nearby community use the biogas to generate energy?

Q5: How is it environmentally beneficial to residents to burn the biogas in a flare, which causes additional air pollution in the region?

Q6: In the landfill survey conducted, were fires at the site taken into account, which may have burned off significant amounts of the biogas?

Q7: Will leachate be addressed in the landfill rehabilitiation?

Q8: How does one rehabilitate a landfill after so many years? Is there landfill settling, which will mean a lack of gas?

C1: The landfill rehabilitation should focus on rehabilitation the actual landfill and not on collecting and burning the biogas, which is less important.

C2: I feel more confident that the landfill site will be rehabilitated now that I see that the Association is seeking means to fund the project. The involvement of the United Nations and other international bodies gives me confidence that the rehabilitation will be undertaken properly with high standards.

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

>>

Each question was answered by the appropriate individual – Yitzchak Kugman, Giora Lieberman or a representative from EcoTraders. All questions and comments were noted and addressed.

A1: All CERs generated from CDM projects that were registered prior to Israel accepting an emission-reduction target will continue to be accepted as voluntary emission-reductions and can be sold to parties seeking CER to meet their reduction targets.

A2: Yes, combusting methane does produce CO_2. Within CDM project, however, these CO_2 are considered to be part of the natural decomposition process of organic material and not anthropogenic CO_2 emissions.

A3: The Association will be publicising a tender for a firm to operate the biogas extraction and combustion.

A4: The biogas can be used to generate electricity or thermal energy. For example, the gas from the Hiriya landfill is being combusted in boilers at Offis Textile to generate steam and thermal energy. Generating energy from the landfill gas can be another CDM project.

A5: The flaring of landfill gas is highly efficient and does not produce soot or significant air pollution. The project activity will not make any significant contribution to air pollution for the area's residents.

A6: The survey consisted of two wells that were drilled and the available gas analysed. We cannot measure gas that was combusted as the result of fires at the landfill, only the gas that currently remains in the landfill.

A7: Leachate will be collected and dealt with as part of the landfill's rehabilitation. It is not part of the CDM project activity.

A8: Landfill settling does not affect the gas because the volume of the landfill is related to the amount of waste, not to the amount of gas. Landfill rehabilitation can take place at any time. It is true that there will be less biogas available in the landfill if extraction takes place long after the landfill ceases operations. Whatever gas is still available is available; whatever gas already has been released to the atmosphere is lost.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	EcoTraders Ltd.
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E-Mail:	
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Represented by:	
Title:	Director
Salutation:	Mr.
Last Name:	Kugman
Middle Name:	
First Name:	Yitzchak
Department:	
Mobile:	
Direct FAX:	

Direct tel:	
Personal E-Mail:	egood@sviva.org

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No public funding is or will be available for this project.

Annex 3

BASELINE INFORMATION

Summary Report

Landfill Name or Identifier: Retamim רתמים

Date: 2007 יום חמישי 08 מרץ

About LandGEM:

First-Order Decomposition Rate Equation:

$$Q_{CH_4} = \sum_{i=1}^{n} \sum_{j=0.1}^{1} k L_o \left(\frac{M_i}{10} \right) e^{-k t_{ij}}$$

Where,

Q_{CH4} = annual methane generation in the year of the calculation *(m^3/year)*

i = 1-year time increment

n = (year of the calculation) - (initial year of waste acceptance)

j = 0.1-year time increment

k = methane generation rate (*$year^{-1}$*)

L_o = potential methane generation capacity (*m^3/Mg*)

M_i = mass of waste accepted in the i^{th} year (*Mg*)

t_{ij} = age of the j^{th} section of waste mass M_i accepted in the i^{th} year (*decimal years*, e.g., 3.2 years)

LandGEM is based on a first-order decomposition rate equation for quantifying emissions from the decomposition of landfilled waste in municipal solid waste (MSW) landfills. The software provides a relatively simple approach to estimating landfill gas emissions. Model defaults are based on empirical data from U.S. landfills. Field test data can also be used in place of model defaults when available. Further guidance on EPA test methods, Clean Air Act (CAA) regulations, and other guidance regarding landfill gas emissions and control technology requirements can be found at http://www.epa.gov/ttnatw01/landfill/landflpg.html.

LandGEM is considered a screening tool — the better the input data, the better the estimates. Often, there are limitations with the available data regarding waste quantity and composition, variation in design and operating practices over time, and changes occurring over time that impact the emissions potential. Changes to landfill operation, such as operating under wet conditions through leachate recirculation or other liquid additions, will result in generating more gas at a faster rate.

Defaults for estimating emissions for this type of operation are being developed to include in LandGEM along with defaults for convential landfills (no leachate or liquid additions) for developing emission inventories and determining CAA applicability. Refer to the Web site identified above for future updates.

Input Review

LANDFILL CHARACTERISTICS		
Landfill Open Year	**1978**	
Landfill Closure Year (with 80-year limit)	**2003**	
Actual Closure Year (without limit)	***2003***	
Have Model Calculate Closure Year?	**No**	
Waste Design Capacity		*short tons*
MODEL PARAMETERS		
Methane Generation Rate, k	**0.020**	*$year^{-1}$*
Potential Methane Generation Capacity, L_o	**100**	*m^3/Mg*
NMOC Concentration	**600**	*ppmv as hexane*
Methane Content	**50**	*% by volume*

WASTE ACCEPTANCE RATES

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	***(short tons/year)***	***(Mg)***	***(short tons)***
1978	93,000	102,300	0	0
1979	99,000	108,900	93,000	102,300
1980	105,000	115,500	192,000	211,200
1981	111,000	122,100	297,000	326,700
1982	117,500	129,250	408,000	448,800
1983	124,500	136,950	525,500	578,050
1984	132,000	145,200	650,000	715,000
1985	140,000	154,000	782,000	860,200
1986	148,000	162,800	922,000	1,014,200

1987	170,000	187,000	1,070,000	1,177,000
1988	170,000	187,000	1,240,000	1,364,000
1989	170,000	187,000	1,410,000	1,551,000
1990	170,000	187,000	1,580,000	1,738,000
1991	170,500	187,550	1,750,000	1,925,000
1992	175,000	192,500	1,920,500	2,112,550
1993	186,000	204,600	2,095,500	2,305,050
1994	200,000	220,000	2,281,500	2,509,650
1995	277,000	304,700	2,481,500	2,729,650
1996	430,312	473,343	2,758,500	3,034,350
1997	431,718	474,890	3,188,812	3,507,693
1998	341,888	376,077	3,620,530	3,982,583
1999	486,487	535,136	3,962,418	4,358,660
2000	393,876	433,264	4,448,905	4,893,796
2001	343,580	377,938	4,842,781	5,327,059
2002	446,710	491,381	5,186,361	5,704,997
2003	250,568	275,625	5,633,071	6,196,378

Results

Year	Total landfill gas			Methane		
	(Mg/year)	*(m^3/year)*	*(short tons/year)*	*(Mg/year)*	*(m^3/year)*	*(short tons/year)*
1978	0	0	0	0	0	0
1979	4.604E+02	3.687E+05	5.064E+02	1.230E+02	1.843E+05	1.353E+02
1980	9.414E+02	7.538E+05	1.036E+03	2.515E+02	3.769E+05	2.766E+02
1981	1.443E+03	1.155E+06	1.587E+03	3.853E+02	5.776E+05	4.239E+02
1982	1.964E+03	1.572E+06	2.160E+03	5.245E+02	7.862E+05	5.769E+02
1983	2.506E+03	2.007E+06	2.757E+03	6.695E+02	1.003E+06	7.364E+02
1984	3.073E+03	2.461E+06	3.380E+03	8.209E+02	1.230E+06	9.029E+02

Results (Continued)

Year	Total landfill gas			Methane		
	(Mg/year)	*(m^3/year)*	*(short tons/year)*	*(Mg/year)*	*(m^3/year)*	*(short tons/year)*
1985	3.666E+03	2.935E+06	4.032E+03	9.791E+02	1.468E+06	1.077E+03
1986	4.286E+03	3.432E+06	4.715E+03	1.145E+03	1.716E+06	1.259E+03
1987	4.934E+03	3.951E+06	5.427E+03	1.318E+03	1.975E+06	1.450E+03
1988	5.678E+03	4.547E+06	6.246E+03	1.517E+03	2.273E+06	1.668E+03
1989	6.407E+03	5.131E+06	7.048E+03	1.711E+03	2.565E+06	1.883E+03
1990	7.122E+03	5.703E+06	7.834E+03	1.902E+03	2.851E+06	2.093E+03
1991	7.822E+03	6.264E+06	8.605E+03	2.089E+03	3.132E+06	2.298E+03
1992	8.512E+03	6.816E+06	9.363E+03	2.274E+03	3.408E+06	2.501E+03
1993	9.209E+03	7.374E+06	1.013E+04	2.460E+03	3.687E+06	2.706E+03
1994	9.948E+03	7.966E+06	1.094E+04	2.657E+03	3.983E+06	2.923E+03
1995	1.074E+04	8.601E+06	1.182E+04	2.869E+03	4.300E+06	3.156E+03
1996	1.190E+04	9.529E+06	1.309E+04	3.179E+03	4.764E+06	3.496E+03
1997	1.379E+04	1.105E+07	1.517E+04	3.685E+03	5.523E+06	4.053E+03
1998	1.566E+04	1.254E+07	1.722E+04	4.183E+03	6.269E+06	4.601E+03
1999	1.704E+04	1.365E+07	1.875E+04	4.552E+03	6.823E+06	5.007E+03
2000	1.911E+04	1.530E+07	2.102E+04	5.105E+03	7.652E+06	5.616E+03
2001	2.068E+04	1.656E+07	2.275E+04	5.525E+03	8.281E+06	6.077E+03
2002	2.197E+04	1.760E+07	2.417E+04	5.870E+03	8.798E+06	6.457E+03
2003	2.375E+04	1.902E+07	2.613E+04	6.344E+03	9.509E+06	6.979E+03
2004	2.452E+04	1.964E+07	2.697E+04	6.550E+03	9.818E+06	7.205E+03
2005	2.404E+04	1.925E+07	2.644E+04	6.420E+03	9.623E+06	7.062E+03
2006	2.356E+04	1.887E+07	2.592E+04	6.293E+03	9.433E+06	6.922E+03
2007	2.309E+04	1.849E+07	2.540E+04	6.168E+03	9.246E+06	6.785E+03
2008	2.264E+04	1.813E+07	2.490E+04	6.046E+03	9.063E+06	6.651E+03
2009	2.219E+04	1.777E+07	2.441E+04	5.927E+03	8.883E+06	6.519E+03
2010	2.175E+04	1.742E+07	2.392E+04	5.809E+03	8.708E+06	6.390E+03

Results (Continued)

Year	Total landfill gas			Methane		
	(Mg/year)	(m^3/year)	(short tons/year)	(Mg/year)	(m^3/year)	(short tons/year)
2011	2.132E+04	1.707E+07	2.345E+04	5.694E+03	8.535E+06	6.264E+03
2012	2.090E+04	1.673E+07	2.299E+04	5.581E+03	8.366E+06	6.140E+03
2013	2.048E+04	1.640E+07	2.253E+04	5.471E+03	8.200E+06	6.018E+03
2014	2.008E+04	1.608E+07	2.208E+04	5.363E+03	8.038E+06	5.899E+03
2015	1.968E+04	1.576E+07	2.165E+04	5.256E+03	7.879E+06	5.782E+03
2016	1.929E+04	1.545E+07	2.122E+04	5.152E+03	7.723E+06	5.668E+03
2017	1.891E+04	1.514E+07	2.080E+04	5.050E+03	7.570E+06	5.555E+03
2018	1.853E+04	1.484E+07	2.039E+04	4.950E+03	7.420E+06	5.445E+03
2019	1.817E+04	1.455E+07	1.998E+04	4.852E+03	7.273E+06	5.338E+03
2020	1.781E+04	1.426E+07	1.959E+04	4.756E+03	7.129E+06	5.232E+03
2021	1.745E+04	1.398E+07	1.920E+04	4.662E+03	6.988E+06	5.128E+03
2022	1.711E+04	1.370E+07	1.882E+04	4.570E+03	6.850E+06	5.027E+03
2023	1.677E+04	1.343E+07	1.845E+04	4.479E+03	6.714E+06	4.927E+03
2024	1.644E+04	1.316E+07	1.808E+04	4.391E+03	6.581E+06	4.830E+03
2025	1.611E+04	1.290E+07	1.772E+04	4.304E+03	6.451E+06	4.734E+03
2026	1.579E+04	1.265E+07	1.737E+04	4.218E+03	6.323E+06	4.640E+03
2027	1.548E+04	1.240E+07	1.703E+04	4.135E+03	6.198E+06	4.548E+03
2028	1.517E+04	1.215E+07	1.669E+04	4.053E+03	6.075E+06	4.458E+03
2029	1.487E+04	1.191E+07	1.636E+04	3.973E+03	5.955E+06	4.370E+03
2030	1.458E+04	1.167E+07	1.604E+04	3.894E+03	5.837E+06	4.283E+03
2031	1.429E+04	1.144E+07	1.572E+04	3.817E+03	5.721E+06	4.199E+03
2032	1.401E+04	1.122E+07	1.541E+04	3.741E+03	5.608E+06	4.116E+03
2033	1.373E+04	1.099E+07	1.510E+04	3.667E+03	5.497E+06	4.034E+03
2034	1.346E+04	1.078E+07	1.480E+04	3.595E+03	5.388E+06	3.954E+03
2035	1.319E+04	1.056E+07	1.451E+04	3.523E+03	5.281E+06	3.876E+03
2036	1.293E+04	1.035E+07	1.422E+04	3.454E+03	5.177E+06	3.799E+03

BIOGAS SYSTEM ENERGY DEMAND ex-ante calculation

Hiriya	October	November	December	January	February
Month's start (MWh)	21.8	25.07	28.7	32.42	36.47
Month's end (MWh)	24.95	28.61	32.31	36.28	40.91
Total (MWh)	**3.15**	**3.54**	**3.61**	**3.86**	**4.44**
Average monthly energy demand (MWh)					**3.72**

CALCULATION OF THE GRID EMISSION FACTOR

Build Margin Calculation:

20% of electricity generated	10,072,937
Electricity generated in 5 plants built recently	1,810,724
Electricity generated in 6 plants built recently	17,837,277
Therefore chose last 6 plants to include in BM claculation as plant #6 falls in part of 20% of electricity generated. As specified in ACM002.	

Build Margin Calculation:

Total emissions 3 yrs	53,170,750
Total generation 3 yrs	54,771,679
BM	0.971

$$EF_{OM,y} = \frac{\sum_{i,j} F_{i,j,y} . COEF_{i,j}}{\sum_{j} GEN_{j,y}}$$

Operating Margin Calculation:

Total emissions 3 yrs	131,539,501
Total generation 3 yrs	145,723,917
OM	0.903

Combined Margin

BM	0.971
OM	0.903
CM	0.937