CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-SSC-PDD)
Version 03 - in effect as of: 22 December 2006

CONTENTS

Revision history of this document

Version Number	**Date**	**Description and reason of revision**
01	21 January 2003	Initial adoption
02	8 July 2005	• The Board agreed to revise the CDM SSC PDD to reflect guidance and clarifications provided by the Board since version 01 of this document. • As a consequence, the guidelines for completing CDM SSC PDD have been revised accordingly to version 2. The latest version can be found at <http://cdm.unfccc.int/Reference/Documents>.
03	22 December 2006	• The Board agreed to revise the CDM project design document for small-scale activities (CDM-SSC-PDD), taking into account CDM-PDD and CDM-NM.

SECTION A. General description of small-scale project activity

A.1 Title of the small-scale project activity:

Alton Landfill Gas to Energy Project
Document Version Number 1
Date completed 13 April 2008

A.2. Description of the small-scale project activity:

The Alton Landfill Gas to Energy Project (hereafter, the "Project") developed by ENER*G Systems uMhlathuze (PTY) LTD (hereafter referred to as the "Project Developer") is a landfill gas (LFG) collection and utilisation project in Richards Bay in the City of uMhlathuze, in the Province of KwaZulu-Natal, South Africa, hereafter referred to as the "Host Country".

The Alton Landfill is a closed landfill site which was operational from 1982 to 2004. During that time approximately 1.7 million tonnes of municipal and construction waste have been deposited at this site. The landfill includes a leachate collection system, and a leachate basin. No passive or active gas collection system is in place.

In the baseline scenario, methane is emitted freely from the landfill to the atmosphere. The Project involves the avoidance of methane emissions as well as the displacement of electricity from the South African coal-based grid, resulting in a consequent reduction in CO_2 emissions.

The objective of the Project is to collect and destruct/utilize the LFG generated at the closed Alton landfill. The purpose of LFG flaring is to dispose of the flammable constituents, particularly methane, safely and to control odour nuisance, health risks and adverse environmental impacts. Hence this will involve investing in a highly efficient gas collection system as well as flaring equipment.

The project activity includes two distinct stages. In the first stage, the methane will only be captured and destroyed by using a LFG flare, while in the second stage the captured methane will be fed to the LFG flare and a modular electricity generation plant. The generator will combust the methane in the LFG to produce electricity for export to a local power purchaser. Excess LFG, and all gas collected during periods when electricity is not produced, will be flared. The maximum installed capacity is expected to be approximately 0.4 MW.[1]

The Project is estimated to reduce greenhouse gas emissions by 26,443 tCO_{2e}/year on average over 10 years. These emission reductions will be constituted by methane emission reductions, through the capture and flaring of LFG and the generation of electricity from captured landfill gas, as well as CO_2 emission reductions in Phase 2, through the displacement of coal-based electricity from the grid.

Moreover, the Project is helping the Host Country to fulfil its goals of promoting sustainable development, and will have several positive social and environmental impacts:

[1] The potential of the gas flow from the site may support a higher installed capacity (up to 0.5MW) in the future.

- First, the Project promotes the integration of infrastructure which will improve environmental conditions. The installed landfill gas collection and flaring system will prevent potentially explosive situations associated with the subsurface gas migration, as it represents an effective control system which minimises gas migration off-site.
- Second, many constituents of landfill gas are hazardous and pose a potentially significant risk to human health. The objective of LFG flaring is to dispose of the perilous constituents, particularly methane, safely and to control and reduce odour nuisance and health risks.
- Third, the Project minimises environmental damage through reduced methane emissions.
- Fourth, the Project can provide a model for LFG management, a key element in improving landfill management practices throughout the Host Country.
- Fifth, the Project optimises the use of natural resources and will act as a clean technology demonstration project, encouraging less dependency on grid-supplied electricity. By doing so, sustainable and diverse energy systems are promoted.
- Finally, the Project seeks to increase employment opportunities in the area where the Project is located. It will provide for both short- and long-term employment opportunities for local people. Local contractors and labourers will be required for construction, and long-term staff will be contracted to operate and maintain the system.

A.3. Project participants:

Table: Project participants

Name of party involved (*) ((host) indicates a host party)	**Private and/or public entity(ies) Project participants (*) (as applicable)**	**Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)**
South Africa (host)	ENER·G Systems uMhlathuze (PTY) LTD (private entity)	No
United Kingdom of Great Britain and Northern Ireland	EcoSecurities Group PLC (private entity)	No

(*) In accordance with the CDM modalities and procedures, at the time of making the CDM-PDD public at the stage of validation, a Party (country) involved may or may not have provided its approval. At the time requesting registration, the approval by the Party(ies) involved is required.

Further contact information of project participants is provided in Annex 1.

A.4. Technical description of the small-scale project activity:

A.4.1. Location of the small-scale project activity:

A.4.1.1. Host Party(ies):

South Africa (the "Host Country")

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

Province of KwaZulu-Natal (KZN)

A.4.1.3. City/Town/Community etc:

Richards Bay in the City of uMhlathuze.

A.4.1.4. Details of physical location, including information allowing the unique identification of this small-scale project activity :

The Project is located in the industrial area of Richards Bay, on Alumina Alley and Corner of John Ross highway, approximately 5 km southwest from the city centre.

The GPS coordinates are 28º46'09.33'' South / 32º01'06.10'' East.

A.4.2. Type and category(ies) and technology/measure of the small-scale project activity:

According to Annex A of the Kyoto Protocol, this Project fits in Sectoral Categories:

1. Energy Industry, and;

13. Waste Handling and Disposal.

Methodologies and tools to be used in the Project include:

- AMS I D: '*Grid connected renewable electricity generation*' v13
- AMS III G: '*Landfill methane recovery*' v6
- '*Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site'* v2, EB35
- '*Tool to calculate the emission factor for an electricity system'* v1, EB 35

A detailed description of the technology to be employed in the Project, through which emission reductions are facilitated, is provided below.

Landfill Gas Collection System

The provider of the Gas Collection and Flaring Technology has over twenty years of practical experience in the design, installation and operation of LFG collection systems. The project activity involves the installation of state of the art LFG collection technology. This includes:

- Vertical gas wells drilled into the waste to extract the LFG. The gas wells cover the area of the landfill available for gas extraction and are spaced on a site-specific grid to maximise LFG collection.

- A gas collection pipe network which consists of pipes that connect groups of gas wells to the manifolds. The manifolds are connected into a main pipe and then into the main header pipe which delivers the gas to the extraction plant and the flare. The system is modular, so it is relatively easy to extend it on parts of the landfill available for gas extraction in the future.
- Dewatering points at strategic low points of the gas collecting work which allow effective condensate management by returning the condensate back to landfill.
- Blower(s) which draw the gas from the wells through the collection system and deliver it to the flare or gas fuelled internal combustion engine powering electricity generator.
- An impermeable cover material.

Trained, experienced staff will be employed to ensure that the gas collection system is installed correctly. A large portion of the labour for maintenance and operations will be sourced locally. The Project Developer's senior management personnel provide technical support throughout the Project to the local personnel employed on the ground.

Flare Technology

The technology provider has designed, manufactured and installed skid / base mounted and mobile gas flares for burning LFG for over twenty years. Enclosed stacks provide conditions for high temperature combustion to effectively destruct methane.

- The project activity involves the installation of a modular enclosed gas flare designed for a maximum capacity of 500 m^3/h, consisting of pipe work, valves, blower, stack with proprietary burners, instrumentation and control panel.

Electricity Generation Technology

The Project Developer, who has extensive experience in the design, building, and operation of generators using LFG will develop the electricity generation component of the project activity.

- The packaged generation system consists of an outdoor containerised generating set comprising an engine and alternator set. The engine unit comprises a fully containerised gas engine, with a control room and its own transformer and switch gear. These units are designed to be fully mobile. The containers are fully sealed (no floor penetrations) to avoid spreading oil through leaks onto the ground, therefore they can be referred to as environmentally compliant. As the gas production increases or decreases (gas production curve) the containerised engine units can be easily added or taken away to match the gas production. These generators are designed and built by the ENER*G Group in Manchester.

The generation facility will employ full time staff for operation, routine servicing and repairs.

The technology used in the project activity to collect, flare and utilise the LFG comes from the UK. Equipment will be imported and installed in South Africa, representing a transfer of technology.

A.4.3 Estimated amount of emission reductions over the chosen crediting period:

Table: Estimated emission reductions from the Project

Year	**Estimation of emission reductions (tonnes of CO_2e)**
2008 (Oct - Dec)	9,945
2009	36,457
2010	33,462
2011	30,757
2012	28,311
2013	26,097
2014	24,091
2015	22,270
2016	20,617
2017	19,114
2018 (Jan - Sep)	13,310
Total estimated reductions (tonnes of CO_2e)	264,431
Total number of crediting years	**10**
Annual average over the crediting period of estimated reductions (tonnes of CO2e)	26,443

A.4.4. Public funding of the small-scale project activity:

The Project will not receive any public funding from Parties included in Annex I of the UNFCCC.

A.4.5. Confirmation that the small-scale project activity is not a debundled component of a large scale project activity:

Based on the information provided in Appendix C of the Simplified Modalities and Procedures for Small-Scale CDM project activities[2], the Project is not a part of any large scale project or program and is not a debundled component of a large project activity.

The project participants have not registered or are not applying to register any other small-scale CDM project activity:

- With the same project participants;
- In the same project category and technology/measure; and
- Registered within the previous 2 years; and
- Whose project boundary is within 1 km of the project boundary of the proposed small scale activity at the closest point.

[2] See: http://cdm.unfccc.int/Projects/pac/howto/SmallScalePA/sscdebund.pdf

SECTION B. Application of a baseline and monitoring methodology

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

Based on Appendix B of the simplified modalities and procedures for small-scale CDM project activities, the following Methodologies will be used.

- AMS III G version 6, adopted at EB38, "Landfill methane recovery" for the LFG component, and
- AMS- I.D version 13, adopted at EB36, "Grid connected renewable electricity generation" for the electricity generation component.

The Methodologies refer to the following tools:

- "Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site" – version 2, adopted at EB35.
- "Tool to calculate the emission factor for an electricity system" version 1, adopted at EB35.

B.2 Justification of the choice of the project category:

The Project is based on two complementary activities, as follows:

- The collection and flaring or combustion of LFG, thus converting its methane content into CO_2, reducing its greenhouse gas effect; and
- The generation and supply of electricity to a local power purchaser, thus displacing more carbon intensive electricity from the national grid.

The Project therefore fulfils the conditions of AMS-III.G. methodology applicability criteria (i.e. measures to capture and combust methane from landfills; and electrical energy generation), in addition to not exceeding the 60ktCO_2e per year threshold (see table B.6.4.1), and therefore AMS-III.G. was considered the most appropriate methodology for the LFG component of this Project.

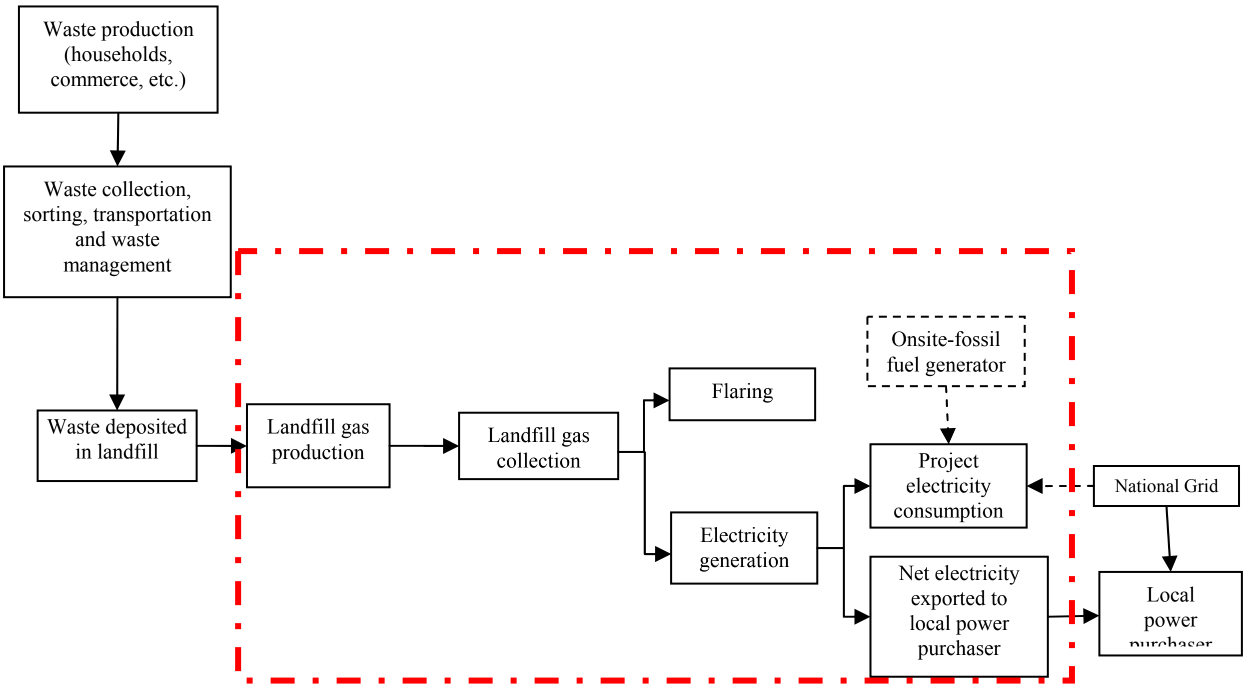
AMS-III.G. states that in the case of direct electricity generation, that component of the Project can use the corresponding category under Type I. Therefore the approved small-scale methodology AMS-I.D. for renewable electricity generation for a grid can be applied since the planned capacity for the proposed project activity is 400 kW, and hence below the threshold for small scale projects (15MW). This category comprises renewable energy generation units that supply electricity to an electricity distribution system that is or would have been supplied by at least one fossil fuel fired generating unit. The Project supplies electricity to a grid connected local power purchaser, therefore displacing electricity from the national grid and fulfilling the applicability criteria of AMS-I.D methodology.

B.3. Description of the project boundary:

According to AMS-III.G., the project boundary is the physical, geographical site of the landfill where the gas is captured and destroyed/used. According to AMS-I.D., the project boundary should encompass the physical, geographical site of the renewable generation source.

A flow diagram of the project boundaries is presented in the figure below. The flow diagram comprises all possible elements of the LFG collection systems and the equipment for electricity generation.

Figure B.3.1: Flow chart of project boundaries (staggered red line indicates boundary, staggered black line indicates possible scenarios for the electricity consumption by the project activity)



B.4. Description of baseline and its development:

In the baseline scenario the accumulated waste is left to decay in the landfill and the methane is emitted to the atmosphere since neither an active nor a passive gas collection system is in place. Although landfill gas has been recognised as a source of odour and as a potential explosion hazard, few gas management systems have been constructed in Southern Africa[3], and as a result landfill gas management at most sites in southern Africa is currently limited to passive venting of gas[4].

[3] Department of Water Affairs and Forestry, 1998: Minimum requirements for waste disposal by landfill, chapter 8.4.6 Gas Management Systems, page 8-11

[4] Department of Water Affairs and Forestry, 2005: Minimum requirements for waste disposal by landfill, draft 3rd edition, Chapter 8.4.6 Gas management systems, page 99

In few cases where landfills do count with an active gas collection system, the gas collection system was either installed to carry out a pumping trial to collect data for feasibility studies prior to CDM project activities or it turned out to be an uneconomical activity and thus was shut down after a short period.

Regulatory requirements do not indicate any specific amount of gas collection and destruction or utilisation.

The baseline scenario is the situation where, in the absence of the project activity, landfill gas is not collected or utilised in any way and as such methane is emitted to the atmosphere. Baseline emissions are calculated as 'methane emission potential' minus the 'methane emissions that would have to be removed to comply with national or local safety requirements or legal regulations'

Two alternatives to the project scenario are considered:

Alternative 1: The proposed project activity without CDM. Addition of landfill gas capture and flaring/electricity generation technology, implemented without considering CDM revenue. This alternative would face investment and other barriers outlined in section B.5 below, and therefore is not considered viable.

Alternative 2: Continuation of the current practice. The landfill gas will continue to be uncollected and methane will continue to be emitted to the atmosphere. This would require no investments on the part of the project developer, and would not face any technological or other barriers. The landfill gas would continue to be emitted into the atmosphere.

Therefore, Alternative 1 faces more barriers than Alternative 2, and therefore is unlikely to implemented in the absence of the CDM (i.e. is not the baseline scenario).

Variables used to calculate the baseline for the LFG component

Variable	Description	Unit & value applied	Data Source
Φ	Model correction factor to account for model uncertainties	0.9	Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site, v2, EB35
F	Fraction of methane recovered at the SWDS and flared, combusted or used in another manner	0	Project Developer- no LFG captured or utilised on site
GWP_{CH4}	Global Warming Potential of methane	21 t_{CO2}/t_{CH4}	Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site, v2, EB35
OX	Oxidation factor	0.1	Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site, v2, EB35; Project Developer
F	Fraction of methane in the LFG	0.5	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
DOC_f	Fraction of degradable organic carbon that can decompose	0.5	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
MCF	Methane Correction Factor	1	IPCC 2006 Guidelines for National

			Greenhouse Gas Inventories
$W_{j,x}$	Total amount of organic waste type j prevented from disposal in the SWDS in the year x in tons	Tonnes	Project Developer
DOCj	Fraction of Degradable Organic Carbon (by weight) in waste type *j*	-	IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Tables 2.4 and 2.5)
Kj	Decay rate for waste type *j*	-	IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Table 3.3)
J	Waste type category index	-	Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site
X	Start of the project activity - beginning of landfilling	1982	Project Developer
Y	Year for which methane emissions are calculated	2008	EcoSecurities

Variables used to calculate the baseline for the electricity generation component

Variable	Description	Unit & value applied	Data Source
EG	Net Electricity exported by renewable generating unit	2,926 MWh	Project Developer
EF_{grid}	Emission coefficient	0.930 tCO_2e/MWh	Calculated according to the 'Tool to calculate the emission factor for an electricity system'

For detailed information how the baseline was identified, please refer to Section B.5.

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 small-scale CDM project activity:

The determination of project scenario additionality is done using Attachment A of Appendix B of the simplified modalities and procedures for small-scale CDM project activities, which states that additionality can be proved through demonstration of at least one of the following barriers:

- Investment barrier
- Technological barrier
- Barrier due to prevailing practice
- Other barriers

<u>Investment barrier:</u>

Benchmark analysis

The likelihood of development of this Project, as opposed to the continuation of current activities (i.e. neither collection nor venting of LFG) will be determined by comparing its IRR with the benchmark rates of return available to investors in the Host Country.

A relevant benchmark for a project's IRR can be derived from government bond rates increased by a suitable risk premium to reflect private investment and/or project type. To establish a suitable benchmark, the following were used:

- According to the database from Bloomberg, an acknowledged specialist in providing financial data and investment information, the risk free rate (equivalent to government bonds) for South Africa is 9.054%[5]

- Risk premiums generally reflect circumstances related both to the individual country where the investment is taking place and the technology in question.

    - According to Bloomberg, the country risk for South Africa is currently 4.466%.[6]

    - A reliable risk premium related to landfill gas projects (i.e., technology risk) could not be identified due to a lack of public information in this sector. However, it is well known that landfill gas projects throughout the world have encountered difficulties in delivering the projected CERs, and very few LFG projects in South Africa developed under the CDM are generating electricity; an indication that these kind of projects still face significant hurdles. The above suggests that a realistic risk premium for this type of project should be higher than the 4.466% premium indicated by the country risk alone.

Given the above, a realistic benchmark IRR for this type of project should be greater than the base investment threshold (South African government bonds) plus a risk premium, which given the actual figures referenced above is more than 13.52% (9.054% + 4.466%). Thus, a 13.5% benchmark can be considered as a conservative benchmark for the performance of investments in the landfill sector in the Host Country.

The Table below shows the results of the benchmark analysis for the project activity, considering a 15-year period. As shown, the project IRR (without CDM revenue) is significantly lower than the chosen benchmark IRR for private sector investors in the Host Country.

Table B.5.1: Financial results of the Project with and without carbon finance:

	Without CDM	**With CDM**
IRR	8.15	46.34
Discount rate (the chosen benchmark)	13.5%	

[5] Internal Bloomberg database (http://www.bloomberg.com/), See Annex 3: Printout from internal database outlining country risk premium for South Africa, 2 April 2008.

[6] Internal Bloomberg database (http://www.bloomberg.com/), See Annex 3: Printout from internal database outlining country risk premium for South Africa, 2 April 2008.

Table B.5.2: Assumption for cash flow analysis

Input/Assumption	Value	Source
Electricity price (ZAR/MWh)	320	Electricity *base tariff* + *renewable energy tariff*, as agreed on in PPA
Annual increase in electricity base tariff (%/yr)	4.6%[7]	Average 2006,2007 (Eskom annual report 2007,p72)
Depreciation	10%	Standard value
VAT on electricity	14%	http://www.sars.gov.za/home.asp?pid=289
Income tax	29%	http://www.sars.gov.za/home.asp?pid=289#Income%20tax
Price per CER (ZAR)	77.60	Assuming $10 per CER at an exchange rate: 7.76 US$/Rand
Total investment costs for power generation equipment (ZAR)	2,692,663	See attached Financial Calculation
Total investment costs for gas collection and flaring equipment (ZAR)	1,857,391	See attached Financial Calculation
Management and operation costs: electricity generation component per year (ZAR)	67,500	See attached Financial Calculation
Management and operation costs: gas collection and flaring component per year (ZAR)	313,600	See attached Financial Calculation
Project support costs per year (ZAR)	180,000	See attached Financial Calculation

Detailed information on the financial analysis carried out can be found in Annex 3.

A sensitivity analysis was undertaken using assumptions that improve the IRR to the benchmark value. As demonstrated in the table below, the investment cost would have to be 59% lower than anticipated or the electricity tariff would have to increase by 24% annually.

Table B.5.3 – Sensitivity analysis

Scenario	% Change	IRR (%)
Base case	**n/a**	8.15%
Reduction in investment costs	**-59%**	13.54
Escalation of electricity costs	**24%**	13.52%

The sensitivity analysis shows that a considerable variation of major parameters would have to happen in order to improve the equity IRR to the benchmark value. Such a variation is unlikely to occur, specifically, with regard to:

7 According to the PPA, the increase in the electricity tariff will be equal to the annual percentage increase approved by the National Electricity Regulator of South Africa (NERSA) for all electricity producers in South Africa. This is applicable for the base cost, however it is assumed that this increase will also apply to the premium for green energy.

Investment costs:
At a reduction of the investment cost by 59%, the IRR would reach the benchmark value. A reduction in investment costs by 59% is highly unlikely as these costs are based on the cost of equipment required for the Project, which is not likely to decrease substantially.

Electricity cost escalation:
At an escalation rate of 24%, the IRR would reach the benchmark value.
The financial model assumes 4.6% annual escalation of the base electricity. The electricity cost assumed in the model relates to electricity exported to the local power consumer. According to the Eskom 2007 Annual Report, the annual average increase in electricity costs from 2006-2007 is 4.6% and therefore an escalation of 24% is unlikely to happen

In conclusion, the project IRR is not substantial enough to warrant investment in this project even with an increase in electricity cost, or a decrease in investment costs. The installation of a landfill gas to energy project is therefore not viable without consideration of carbon finance, and more specifically the revenue obtained under the CDM.

Barrier due to prevailing practice:

To date there has been limited development of LFG projects in the Host Country. Only a few landfills in the Host Country have been designed to partially collect and flare/or utilise the generated LFG.

'Landfill gas management at most sites in southern Africa is currently limited to passive venting of gas'[8] The prevailing practice in South Africa is therefore to either vent the LFG to ensure that the concentration of methane in any particular area of the landfill stays below hazardous levels, or to not install any kind of capturing system.

Since the publication of "Minimum Requirements for waste disposal by landfill" in 2005, no new proper LFG collection and flaring or utilisation systems have been developed in the Host Country without considering carbon revenues. All projects similar to the proposed project activity are developed under the CDM, and are therefore excluded from the discussion on prevailing practice. .

In an assessment by the World Bank, the status of LFG management for the group of landfill sites visited is described in the table below.

Table B.5.4: The Project control group[9]

Landfill Name	Location	Waste Deposition Rate (tonnes/day)	Current Status
Marie Louise Johannesburg	Gauteng	2000	No system for collecting, venting or flaring LFG

[8] Department of Water Affairs and Forestry, 2005: Minimum requirements for waste disposal by landfill, draft 3rd edition p 99
[9] Observations of Solid Waste Landfills in Developing Countries: Africa, Asia, and Latin America, Lars Mikkel Johannessen with Gabriela Boyer, Urban Development Division, Waste Management Anchor Team, The World Bank, First publication: June 1999

Goudkoppies Soweto	Gauteng	1000	No system for collecting, venting or flaring LFG
Krugersdorp	North West	1000	No system for collecting, venting or flaring LFG
Durban Shongweni	KwaZulu/Natal	700	No system for collecting, venting or flaring LFG
Boipatong	Gauteng	300	Passive system for venting of LFG only (no flaring)
Mobeni	KwaZulu/Natal	1000 + 200-250 t of Hazardous waste	Active gas collection and flaring.
Brits	North West	100	No system for collecting, venting or flaring LFG

Thus, with the exception of a few landfills developing a CDM project, the majority of the other landfills don't have LFG collection and flaring systems. Mobeni probably installed a flaring system due to large amount of hazardous waste on the landfill. The reason for the lack of widespread LFG collection and combustion systems is that that there currently is no law that obligates the capture and destruction (or use) of LFG, nor is there an economic incentive for capturing and utilising the LFG. In summary, the passive venting method is still prevailing practice in landfills throughout the Host Country.

CDM Consideration

The CDM was considered early on in the decision making process of ENER-G Systems uMhlathuze (Proprietary) Limited. The Lease and Gas Rights Agreement between ENER-G Systems uMhlathuze (Proprietary) Limited and the Umlathuze Municipality, signed 14 December 2006, states that '*ENER-G Systems uMhlathuze (Proprietary) Limited intends to enter into an ERPA for the sale and purchase of CERs arising from the combustion of Landfill Gas'*[10] An ERPA was later signed between ENERG-G systems uMhlathuze (Pty) Ltd and Ecosecurities Group plc on 22 March 2007.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

AMS-III.G., v6. EB38 requires that the methane emission potential of a solid waste disposal site will be estimated using the 'Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site'.

According to Version 02 of this tool, baseline emissions are calculated ex-ante using a first order decay (FOD) model, which differentiates between different types of waste with different decay rates and different contents of degradable carbon.

This *ex-ante* estimate is for illustrative purposes, as actual emission reductions will be monitored *ex-post*, according to the methodology.

[10] See Lease and Gas Rights Agreement between ENER-G Systems uMhlathuze (Proprietary) Limited and the Umlathuze Municipality, 2006.

Project Emissions:

Methane Destruction Component

During the first phase of the project, and at all times when no electricity is being generated, electricity will be imported from the grid for the operation of the project facilities, and will be monitored as stated in Section B.7.1. The project emissions are determined with the EF_{grid} listed in Section B.6.2, calculated according to the *'Tool to calculate the emission factor for an electricity system' Version 01.*

Project activity emissions consist of CO_2 emissions related to the power used by the project activity facilities.Therefore project emissions are equivalent to the amount of electricity imported from the grid multiplied by the $EF_{grid,}$ as described below:

$PE_{electricity,\ y} = EL_{imp,y} * EF_{grid}$

Where:

Parameter	Unit	Description
$PE_{electricity,y}$	tCO_2e	Project emissions from electricity use
$EL_{imp,y}$	MWh	Electricity imported from the grid
EF_{grid}	tCO_2e/MWh	Grid Emission Factor

Should there be an emergency situation where a fossil fuel back-up generator is required, emissions from this will also be considered as project emissions and calculated as follows:

$PE_{fossil\ fuel,\ y} = FC_y * EF_{fossil\ fuel}$

Where:

Parameter	Unit	Description
$PE_{fossil\ fuel,\ y}$	tCO_2e	Project emissions from fossil fuel use
$FC_{,y}$	Volume units	Amount of fossil fuel combusted to meet power requirements
$EF_{fossil\ fuel}$	tCO_2e/t	Emission factor of the fossil fuel used

Grid displacement component
Project emissions are not applicable as no fossil fuels will be used to power the generator.

Baseline Emissions

Methane Destruction Component

Baseline emissions are determined ex-ante with the following equation:

$BE_y = BE_{CH4,SWDS,y} – MD_{reg,y}$

Where:

Parameter	Unit	Description
BE_y	tCO_2e	Baseline emission in year *y;*
$BE_{CH4,SWDS,y}$	tCO_2e	Amount of methane produced in year *y;*
$MD_{reg,y}$	tCO_2e	methane emissions that would be captured and destroyed to comply with national or local safety requirement or legal regulations in year y.

Since there are no legal regulations which require that methane emissions be removed, and indeed there is neither an active nor a passive LFG venting system in place, $MD_{reg,y}$ =0.

The formula to calculate ex-ante baseline methane emissions in line with the '*Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site*' is as follows:

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

Where:

Parameter	Unit	Description
Φ	-	Model correction factor to account for model uncertainties
f	-	Fraction of methane recovered at the SWDS and flared, combusted or used in another manner
GWP_{CH4}	t_{CO2}/t_{CH4}	Global Warming Potential of methane
OX	-	Oxidation factor
F	-	Fraction of methane in the LFG
DOC_f	-	Fraction of degradable organic carbon that can decompose
MCF	-	Methane Correction Factor
$W_{j,x}$	tonnes	Total amount of organic waste type j prevented from disposal in the SWDS in the year x in tons
DOCj	-	Fraction of Degradable Organic Carbon (by weight) in waste type *j*
Kj	-	Decay rate for waste type *j*
J	-	Waste type category index
X	Year	Start of the project activity -beginning of landfilling
Y	Year	Year for which methane emissions are calculated

In order to account for the incomplete destruction of all methane fed to the flare (FE 90%), baseline emissions have been adjusted by 0.9.

Grid displacement component

According to AMS I D, the baseline is the KWh produced by the renewable generating unit multiplied by an emission coefficient (measured in kg CO_2/KWh) or tCO_2/MWh.

Electricity generated by the genset unit will be exported to a local power purchaser once internal consumption needs have been met. Net electricity generated will be monitored in the project activity and used to calculate emission reductions as follows:

$BE_{electricity,y} = EG * EF_{grid}$

Where:

Parameter	Unit	Description
$BE_{electricity,y}$	tCO_2e	Baseline emissions from electricity use
EG	MWh	Net Electricity generated and exported to the grid
EF_{grid}	tCO_2e/MWh	Grid Emission Factor

Leakage Emissions:

Methane destruction component

Not applicable as the methane recovery technology is not transferred from another activity.

Grid displacement component:
Not applicable as the energy generating equipment is not transferred from another activity.

Emission Reductions

The emission reduction achieved by the project activity is constituted by both the methane destruction and grid displacement components.

$ER_{y,estimated} = BE_y – PE_y - Leakage$

Where:

Parameter	Unit	Description
$ER_{y,estimated}$	tCO_2e	Estimated emission reduction from both methane destruction and grid displacement
BE_y	tCO_2e	Baseline emissions from both methane destruction and grid displacement
PE_y	tCO_2e	Project emissions from electricity or fossil fuel use (only applicable to methane destruction component)
Leakage	tCO_2e	Leakage emissions from both methane destruction and grid displacement

The actual emission reduction achieved by the project during the crediting period will be calculated using the amount of methane recovered and destroyed/gainfully used by the project activity, calculated as:

$ER_{y,calculated} = (MD_y – MD_{reg,y}) + (BE_{electricity,y}) – PE_y – Leakage$

Where:

Parameter	Unit	Description
$ER_{y,calculated}$	tCO_2e	Calculated emission reduction
MD_y	tCO_2e	CO_2 equivalent of the methane captured and destroyed/gainfully used by the project activity in year y;
$MD_{reg,y}$	tCO_2e	Methane emissions that would be captured and destroyed to comply with national or local safety requirements or legal regulations in the year 'y'
$BE_{electricity,y}$	tCO_2e	Baseline emissions from grid displacement
PE_y	tCO_2e	Project emissions from electricity or fossil fuel use (only applicable to methane destruction component)
Leakage	tCO_2e	Leakage emissions from both methane destruction and grid displacement

In case of flaring/fuelling it shall be measured using the conditions of the flaring process:

$$MD_y = LFG_{burnt,y} * w_{CH4,y} * D_{CH4,y} * FE * GWP_{CH4}$$

Where:

Parameter	Unit	Description
$LFG_{burnt,y}$	Nm^3	Landfill gas flared or used as fuel in the year 'y'
$w_{CH4,y}$	%	Methane content in landfill gas in the year 'y'(mass fraction)
$D_{CH4,y}$	$tonnes/m^3$	Density of methane at the temperature and pressure of the landfill gas in the year 'y'
FE	%	Flare efficiency in the year 'y'
GWP_{CH4}	tCO_2/tCH_4	Global warming potential of methane

A 90% default value for the flare efficiency will be used for the project activity.

All equations and definitions of the parameters applied to obtain the emission reduction from the project activity are listed in Section B.6.3.

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

Table: Data and parameters that are available at validation

Data / Parameter:	$\mathbf{EF_{grid}}$
Data unit:	tCO_2e/MWh
Description:	Emission factor of the grid
Source of data to be Used:	Eskom (South African electricity supply company) 2008; NER (National Electricity Regulator), Electricity Supply Statistics for South Africa 2002 – 2005; IPCC 2006.
Value applied:	**0.930**
Justification of the	The $EF_{grid,y}$ is calculated according to the 'Tool to calculate the emission factor

choice of data or description of measurement methods and procedures actually applied:	for an electricity system'.
Any comment:	Detailed information can be found in Annex 3.

Data / Parameter:	**$EF_{fossil\ fuel}$**
Data unit:	tCO_2/t
Description:	Emission factor of the fossil fuel used
Source of data to be Used:	Calculated
Value applied:	3.24
Justification of the choice of data or description of measurement methods and procedures actually applied:	This is calculated on the basis of CO_2 emission factor * NCV. Values are taken from IPCC (2006) for diesel i.e. 74.8tCO2/TJ (CO_2 emission factor) and 0.0433 TJ/t (NCV).
Any comment:	Only applicable if fossil fuel generator is used.

Data / Parameter:	**D_{CH4}**
Data unit:	tCH_4/Nm^3CH_4
Description:	Methane density
Source of data to be used:	ACM0001 Version 8
Value applied:	0.0007168
Justification of the choice of data or description of measurement methods and procedures actually applied:	
Any comment:	At standard temperature and pressure (0 degree Celsius and 1,013 bar) the density of methane is 0.0007168 tCH_4/Nm^3CH_4.

Data / Parameter:	**GWP_{CH4}**
Data unit:	tCO_2/tCH_4
Description:	Global Warming Potential of methane
Source of data to be used:	IPCC 2006
Value applied:	21
Justification of the choice of data or description of measurement methods and procedures actually applied:	

Any comment:	Valid for the first commitment period. Shall be updated according to any future COP/MOP decisions.

Data / Parameter:	**Flare efficiency**
Data unit:	%
Description:	Flare efficiency in hour h based on default value
Source of data to be used:	Default value from AMS III.G Version 6
Value applied:	90%
Justification of the choice of data or description of measurement methods and procedures actually applied:	Flare efficiency is assumed to be 90% as long as manufacturer's specifications of the flare device are met and temperature of the flare is above 500ºC.
Any comment:	If in any specific hour any of the parameters is out of the range of the specifications, 50% of default value should be used for this specific hour. If at any given time the temperature of the flare is below 500ºC, 0% default value should be used for this period.

Data / Parameter:	**Φ**
Data unit:	-
Description:	Model correction factor to account for model uncertainties
Source of data used:	Default value from Tool to determine 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 :	
Any comment:	

Data / Parameter:	**DOC_f**
Data unit:	-
Description:	Fraction of degradable organic carbon (DOC) that can decompose
Source of data used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value applied:	0.5
Justification of the choice of data or description of measurement methods and procedures actually applied :	A default value of 0.5 is recommended by IPCC.
Any comment:	-

Data / Parameter:	**f**

Data unit:	-
Description:	Fraction of methane captured at the SWDS and flared, combusted or used in another manner
Source of data used:	Project Developer
Value applied:	0%
Justification of the choice of data or description of measurement methods and procedures actually applied :	No methane is captured and flared at the site and no national or local safety requirements or legal regulations enforce LFG capture in the host country.
Any comment:	-

Data / Parameter:	**OX**
Data unit:	-
Description:	Oxidation factor (reflecting the amount of methane from SWDS that is oxidized in the soil or other material covering the waste)
Source of data used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories indicates the choice of value to be applied is ‘0’.
Value applied:	0.1
Justification of the choice of data or description of measurement methods and procedures actually applied :	The site is covered with soil and the IPCC 2006 Guidelines for National Greenhouse Gas Inventories indicates the choice of value to be applied is ‘0.1’ for sites that are covered with oxidising materials such as soil or compost.
Any comment:	

Data / Parameter:	**F**
Data unit:	-
Description:	Fraction of methane in the SWDS gas (volume fraction)
Source of data used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value applied:	0.5
Justification of the choice of data or description of measurement methods and procedures actually applied :	Default value of 0.5 is recommended by the IPCC.
Any comment:	-

Data / Parameter:	**MCF**
Data unit:	-
Description:	Methane correction factor
Source of data used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value applied:	1.0
Justification of the choice of data or	Value for anaerobic managed solid waste disposal sites.

description of measurement methods and procedures actually applied :	
Any comment:	

Data / Parameter:	**DOCj**
Data unit:	-
Description:	Fraction of degradable organic carbon (by weight) in the waste type *j*
Source of data used:	IPCC 2006
Value applied:	Values for wet waste are used.
Justification of the choice of data or description of measurement methods and procedures actually applied :	As per "Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site".
Any comment:	

Waste type *j*	**DOC_j (% wet waste)**	**DOC_j (% dry waste)**
Wood and wood products	43	50
Pulp, paper and cardboard (other than sludge)	40	44
Food, food waste, beverages and tobacco (other than sludge)	15	38
Textiles	24	30
Garden, yard and park waste	20	49
Glass, plastic, metal, other inert waste	0	0

Data / Parameter:	**k_j**
Data unit:	-
Description:	Decay rate for the waste type *j*
Source of data used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Table 3.3)
Value applied:	Values for Boreal and Temperate, Wet are used.

Waste type *j*		Boreal and Temperate (MAT≤20°C) Dry (MAP/PET <1)	Boreal and Temperate (MAT≤20°C) Wet (MAP/PET >1)	Tropical (MAT>20°C) Dry (MAP< 1000mm)	Tropical (MAT>20°C) Wet (MAP> 1000mm)
Slowly degrading	Pulp, paper, cardboard (other than sludge), textiles	0.04	0.06	0.045	0.07
Slowly degrading	Wood, wood products and straw	0.02	0.03	0.025	0.035
Moderately degrading	Other (non-food) organic putrescible garden and park waste	0.05	0.10	0.065	0.17
Rapidly degrading	Food, food waste, sewage sludge, beverages and tobacco	0.06	0.185	0.085	0.40

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

Data / Parameter:	**$W_{j,x}$**
Data unit:	-
Description:	Amount of organic waste type *j* prevented from disposal in the SWDS in the year *x*
Source of data used:	Project Developer
Value applied:	

	Wood and wood products	Pulp, paper and cardboard (other than sludge)	Food, food waste, beverages and tobacco (other than sludge)	Textiles	Garden, yark and park waste	Glass, plastic, metal, other inert
1982	0	4772	3180	0	16417	7951
1983	0	4894	3261	0	16838	8155
1984	0	5019	3345	0	17269	8364
1985	0	5148	3431	0	17712	8579
1986	0	5280	3519	0	18166	8799
1987	0	5416	3609	0	18632	9024
1988	0	5554	3701	0	19110	9256
1989	0	5816	3876	0	20010	9692
1990	0	6090	4058	0	20953	10149
1991	0	6377	4250	0	21940	10627
1992	0	6678	4450	0	22974	11127
1993	0	6992	4659	0	24057	11652
1994	0	7322	4879	0	25190	12201
1995	0	7667	5109	0	26377	12776
1996	0	8028	5350	0	27620	13378
1997	0	8406	5602	0	28922	14008
1998	0	10008	6669	0	34431	16676
1999	0	11914	7939	0	40989	19853
2000	0	14183	9451	0	48796	23634
2001	0	16885	11251	0	58091	28136
2002	0	20101	13395	0	69156	33495
2003	0	23929	15946	0	82328	39875

Justification of the choice of data or description of measurement methods and procedures actually applied :	Total amount of waste deposited per year from 1982 to 2003 for the Alton Landfill was obtained from the Project Developer. The various organic waste streams were determined based upon waste composition data from the uThungulu Regional landfill in Empangeni.
Any comment:	

B.6.3 Ex-ante calculation of emission reductions:

Project emissions:

Project emissions from electricity consumption from the grid:

$PE_{,electricity,y} = EL_{imp,y} * EF_{grid}$

Where:

Parameter	Value	Unit	Comment
EF_{grid}	0.930	tCO_2/MWh	Grid Emission Factor
$EL_{imp,y}$	263	MWh	Electricity imported from grid

$PE_{y,electricity} = 245 tCO_2e/yr$

Please note that Project emissions from electricity will only apply when there is no electricity being generated from the biogas. To be conservative, they have been included in emission reduction estimates throughout the crediting period.

Project emissions from electricity consumption from a fossil fuel generator:

$PE_{fossil\ fuel,\ y} = FC_{,y} * EF_{fossil\ fuel}$

Parameter	Value	Unit	Comment
$FC_{,y}$	-	Volume units	As measured
$EF_{fossilfuel}$	-	tCO_2e/t	3.24 (Diesel)

Project emissions from fossil fuel consumption will only be applicable in cases when there is no electricity generated on-site and no grid electricity available.

Baseline Emissions:

Methane destruction component

For the baseline emission ex-ante calculation the following simplified equation is used since $MD_{reg,y} = 0$ as stated above.

$BE_y = BE_{CH4,SWDS,y}$

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

See section B6.2 for values.

Year	Estimation of Baseline Emissions from Methane destruction per year (tCO_2e)*
$BE_{y,2008\ (Oct-Dec)}$	9,326
$BE_{y,2009}$	33,981
$BE_{y,2010}$	30,986
$BE_{y,,2011}$	28,281
$BE_{y,2012}$	25,835
$BE_{y,2013}$	23,621
$BE_{y,2014}$	21,615
$BE_{y,2015}$	19,794
$BE_{y,2016}$	18,141
$BE_{y,2017}$	16,638
$BE_{y,2018\ (Jan-Sep)}$	11,453

* Note that in order to account for the incomplete destruction of all methane fed to the flare (FE 90%), baseline emissions have been adjusted by 0.9

Grid displacement component

$BE_{electricity,y} = EG * EF_{grid}$

Parameter	Value	Unit	Comment
EG	2,926	MWh/yr	Net electricity generated
EF_{grid}	0.930	tCO_2e/MWh	Grid emission factor

$BE_{electricity,y}$ = 2,721 tCO_2e

Emission reductions:

Simplified equation for ex-ante emission reductions, since leakage emissions are not accounted for under the methodology:

$ER_{y,estimated} = BE_y - PE_y$

Please see Section B6.4 for the summary of overall emission reductions.

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

Table B.6.4.1: Emission Reductions from methane destruction from methane destruction[11]

Year	Estimation of project activity emissions (tonnes of CO_2e)	Estimation of baseline emissions (tonnes of CO_2e)	Estimation of leakage (tonnes of CO_2e)	Estimation of overall emission reductions (tonnes of CO_2e)
2008 (Oct - Dec)	61	9,326	not applicable	9,265
2009	245	33,981	not applicable	33,736

[11] There may be a slight mismatch between these values and the emission reduction calculator due to Xcel rounding.

2010	245	30,986	not applicable	30,741
2011	245	28,281	not applicable	28,036
2012	245	25,835	not applicable	25,590
2013	245	23,621	not applicable	23,376
2014	245	21,615	not applicable	21,370
2015	245	19,794	not applicable	19,549
2016	245	18,141	not applicable	17,896
2017	245	16,638	not applicable	16,393
2018 (Jan - Sep)	184	11,453	not applicable	11,269
Total (tonnes of CO_2e)	**2,450**	**239,671**	**not applicable**	**237,221**

Table: Emission Reductions from grid displacement

Year	**Estimation of project activity emissions (tonnes of CO_2e)**	**Estimation of baseline emissions (tonnes of CO_2e)**	**Estimation of leakage (tonnes of CO_2e)**	**Estimation of overall emission reductions (tonnes of CO_2e)**
2008 (Oct - Dec)	0	680	not applicable	680
2009	0	2,721	not applicable	2,721
2010	0	2,721	not applicable	2,721
2011	0	2,721	not applicable	2,721
2012	0	2,721	not applicable	2,721
2013	0	2,721	not applicable	2,721
2014	0	2,721	not applicable	2,721
2015	0	2,721	not applicable	2,721
2016	0	2,721	not applicable	2,721
2017	0	2,721	not applicable	2,721
2018 (Jan - Sep)	0	2,041	not applicable	2,041
Total (tonnes of CO_2e)	**0**	**27,210**	**not applicable**	**27,210**

Table: Total Emission Reductions from both components[12]

[12] There may be a slight mismatch between these values and the emission reduction calculator due to Xcel rounding.

Year	Estimation of emission reductions from LFG destruction & utilisation (tonnes of CO_2e)	Estimation of emission reductions from grid displacement (tonnes of CO_2e)	Estimation of overall emission reductions (tonnes of CO_2e)
2008 (Oct - Dec)	9,265	680	9,945
2009	33,736	2,721	36,457
2010	30,741	2,721	33,462
2011	28,036	2,721	30,757
2012	25,590	2,721	28,311
2013	23,376	2,721	26,097
2014	21,370	2,721	24,091
2015	19,549	2,721	22,270
2016	17,896	2,721	20,617
2017	16,393	2,721	19,114
2018 (Jan - Sep)	11,269	2,041	13,310
Total (tonnes of CO_2e)	**237,221**	**27,210**	**264,431**

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

B.7.1. Data and parameters monitored:

Parameter:	**$LFG_{burnt,y}$**
Data unit:	Nm^3
Description:	Landfill gas flared or used as fuel in the year *y*
Source of data:	Project Developer
Value of data:	As measured.
Brief description of measurement methods and procedures to be applied:	The amount of methane recovered and gainfully used, fuelled or flared will be monitored ex-post, using continuous flow meters.
QA/QC procedures to be applied (if any):	Flow meter will be subject to a regular maintenance and testing regime to ensure accuracy.
Any comment:	The flow meter will express gas flow in normalized cubic meters, therefore no separate monitoring of pressure (P) and temperature (T) of LFG is necessary to determine density.

Data / Parameter:	**w_{CH4}**
Data unit:	Nm^3CH_4 / Nm^3LFG
Description:	Methane fraction in the Landfill Gas

Source of data to be used:	Project Developer
Value of data:	50% for ex-ante estimation of emission reductions
Description of measurement methods and procedures to be applied:	Methane fraction will be measured with a continuous gas analyser or alternatively with periodical measurements at a 95% confidence level.
QA/QC procedures to be applied:	Gas analyser will be subject to a regular maintenance and testing regime to ensure accuracy.
Any comment:	

Data / Parameter:	$\mathbf{T_{flare}}$
Data unit:	˚C
Description:	Temperature of the flare
Source of data to be used:	Project Developer
Value of data:	> 500ºC for ex-ante estimation of emission reductions
Description of measurement methods and procedures to be applied:	This will be measured with a thermocouple to assure that the highest default flare efficiency can be claimed.
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	**Manufacturer's specifications**
Data unit:	
Description:	
Source of data to be used:	Flare Manufacturer
Value of data:	
Description of measurement methods and procedures to be applied:	Manufacturer's specifications of the flare device will be monitored to ensure that a 90% default efficiency can be applied.
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	$\mathbf{EG_y}$
Data unit:	MWh
Description:	Amount of electricity (net) exported to the power purchaser
Source of data to be used:	Project Developer
Value of data:	2,926 for ex-ante estimation of emission reductions
Description of	Electricity will be measured using an electricity meter.

measurement methods and procedures to be applied:	
QA/QC procedures to be applied:	Electricity meter will be subject to a regular maintenance and testing regime to ensure accuracy.
Any comment:	

Data / Parameter:	**EL_{IMP}**
Data unit:	MWh
Description:	Amount of electricity imported to meet power requirements of project
Source of data to be used:	Grid operator
Value of data:	263 (estimate for ex-ante calculations)
Description of measurement methods and procedures to be applied:	Electricity will be measured using an electricity meter.
QA/QC procedures to be applied:	
Any comment:	This will only be monitored if and when electricity is consumed from the grid.

Data / Parameter:	**FC**
Data unit:	Tonnes
Description:	Amount of fossil fuel combusted to meet power requirements of project (when applicable)
Source of data to be used:	Project Developer
Value of data:	
Description of measurement methods and procedures to be applied:	If this parameter is not monitored in mass but in volume units, the density of diesel (0.84kg/l) will be used to calculate tonnes.
QA/QC procedures to be applied:	
Any comment:	This will only be monitored if and when fossil fuel is used to generate power.

B.7.2 Description of the monitoring plan:

The monitoring plan details the actions necessary to record all relevant variables and factors required by the methodology AMS.III.G., v6, EB38, AMS-I.D. and tools the methodologies draws upon, as detailed in section B.7.1 above. The monitoring plan for this Project has been developed to ensure that from the start, the Project is well organised in terms of the collection and archiving of complete and reliable data.

<u>Data collection and record keeping arrangements</u>

All CDM relevant data will be measured & collected as detailed in section B.7.1. All data required for verification and issuance will be backed-up and kept for at least two years after the end of the crediting period or the last issuance of CERs of this project, whichever occurs later.

Data collected on site will be compiled in an electronic format which will be sent to EcoSecurities on a regular basis.

Data Quality Control and Quality Assurance
All data collected on site will be checked internally before being compiled in an electronic format to assure it is complete and of an appropriate quality.

EcoSecurities will perform a regular final check of the data and analyse project performance prior to any verification. Moreover, regular internal audits will be conducted to assure that the project is in compliance with CDM requirements.

Procedures will be developed to deal with possible monitoring data adjustments and uncertainties as well as emergencies.

Maintenance and Calibration of monitoring equipment
All equipment will be maintained and calibrated in line with manufacturer's recommendations. This will assure that the equipment operates at the stated level of accuracy.

Staff training
Training is conducted on site at regular intervals to ensure that staff is capable to perform their designated tasks at high standards. This will include CDM specific training to warrant that they understand the importance of complete and accurate data and records for CDM monitoring.

CDM monitoring organisation and management
Prior to the start of the crediting period, the organisation of the monitoring team will be finalised. Clear roles and responsibilities will be assigned to all staff involved in the CDM project. The Project Developer will have a designated CDM Monitoring Manager who will be responsible for monitoring emissions reductions of the project activity. All staff involved in the collection of data and records will be coordinated by him.

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

Date of completion of the baseline and monitoring methodology: 13 April 2008
Person/entity:
Jennifer Orr
Ecosecurities South Africa (Pty) Ltd
Twickenham Building, The Campus
Cnr Main Rd & Sloane Street, Bryanston
South Africa
Phone: +27 (0) 11 575 6203
e-mail: Jennifer.orr@ecosecurities.com

Detailed baseline information is attached to Annex 3.

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:

April 2008 (date when all approvals were received necessary to start implementing the project)

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

Approximately 15 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:

Not applicable

C.2.1.2. Length of the first crediting period:

Not applicable

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

01/10/2008 (or on the date of registration of the CDM project activity, whichever is later)

C.2.2.2. Length:

10 years

SECTION D. Environmental impacts

D.1. If required by the host Party, documentation on the analysis of the environmental impacts of the project activity:

The Project will actively collect and combust LFG, thereby improving overall landfill management and reducing adverse global and local environmental effects of uncontrolled releases of landfill gas. Whilst the main global environmental concern over gaseous emissions of methane, is the fact that it is a potent greenhouse gas, and thus contributes to climate change, emissions of LFG can also have significant health and safety implications at the local level. For example:

- Risk of explosions and/or fires either within the landfill or outside its boundaries, although the majority of LFG emissions are quickly diluted in the atmosphere;
- Asphyxiation and/or toxic effects to humans from concentrated emissions of LFG;
- Local and global environmental effects such as odour nuisances, stratospheric ozone layer depletion, and ground-level ozone creation due to over 150 trace components contained in landfill gas.

Through both the installation of a well-designed LFG collection and a destruction/utilisation system and its proper operation, LFG will be captured and combusted in a controlled way, thereby removing safety risks from the surrounding community, reducing the risks of toxic effects on the local community and the local environment as well as reducing the emissions of a potent greenhouse gas.

It is worth noting that the Project Developer will install a flare and electricity generation units which comply with stringent UK emission standards, thereby minimising the environmental impact from this particular source and suggesting that these emissions are significantly less harmful than the continued uncontrolled release of LFG. The Project will significantly reduce odour and greenhouse gas emissions.

Thus, the project activity can be seen as environmentally ameliorative, and the installation of the LFG collection and combustion system is part of a broader effort by the landfill operator to continue to improve waste management practices.

In South Africa nevertheless, it is a legal requirement that an independent professional body conducts the Environmental Impact Assessment which needs to be submitted to the Department of Agriculture and Environmental Affairs (DAEA) for approval. Hence a local Consultant made the assessment for the Alton landfill site and, compiled the entire Scoping Report which will be made available for the DOE on request.

The potential environmental impacts identified in the Scoping Report in the different project phases are:

- **Pre-construction (Design) Phase**
  Surface and groundwater impacts

- **Construction Phase**
  Employment opportunities
  Dust
  Noise
  Waste disposal
  Safety
- **Operational Phase**
  Solid waste Management
  Vegetation
  Noise
  Safety

Identified issues are addressed in Section D.2.

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:

Identified environmental impacts	Measures taken
Design Phase: Surface and groundwater impacts	
Run-off from washing vehicles	Washbay has been designed and effluent will be redirected into a soapkit and percolation trench to reduce the potential impact on surface water quality.
Stormwater	This does not relate the project activity as it forms part of the landfill management.
Construction Phase	
Employment opportunities	Temporary employment opportunities will be made available where possible during construction phase.
Dust	Construction areas will be wetted frequently to suppress dust; vegetation cover will only be cleared from areas where construction is imminent.
Noise	Appropriate measures will be taken to minimize noise levels.
Waste disposal	Waste generated during the construction phase will be confined in a legally acceptable manner.
Safety	All employees must be made aware of risks associated with landfill gas.
Operational Phase	
Solid waste management	Waste generated during the operational phase will be confined in a legally acceptable manner.
Vegetation	The impact on vegetation will be minimal, thus simple rehabilitation measures can be taken.
Noise	The packaged generation system consists of an outdoor containerised generating set to reduce noise levels.
Safety	All employees must be made aware of risks associated with landfill gas.

SECTION E. Stakeholders' comments

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

The following description is based on the *Alton Landfill Scoping Report* that was completed by a local consultant.[13] An official notice for the proposed project activity was placed in "The Zululand Observer" on the 15th March 2007 wherein all interested and affected parties were given 14 days to respond and comment. Further, individual meetings to discuss the project were held with the community representatives and the surrounding industries in the area. In particular, the following authorities have been advised of the proposed project activity:

- KZN Department of Agriculture & Environmental Affairs (DAEA)

[13] Geomeasure Group (PTY) was appointed by the Project Developer to carry out the environmental scoping for the development of the CDM project at the Alton Landfill site. The *Scoping Report* covers the Scoping Phase of the Environmental Impact Assessment (EIA) process as specified by Section 26 of the Environmental Conservation Act (Act 73 of 1989) and the Public Participation of the proposed CDM activity. For further details the *Scoping Report* will be made available for the validators.

- uMhlathuze Municipality
- Department of Water Affairs and Forestry (DWAF)

In addition to the public participation process undertaken by the consultant, the project was announced in the regional newspaper "The Mercury" to inform stakeholders comprehensively about the proposed project activity as well as in an official local newsletter from the Municipality "uMhlthuze news", and the "African Energy Journal". A presentation was also made to the "Richards Bay Clean Air Association" by the Project Developer which allowed stakeholders to understand the basic concepts related to climate change, its consequences and the aims of the Kyoto Protocol, as well as the most important features of the Alton Landfill Gas to Energy Project.

Table[14]: Summary of Public and Authority Involvement to date

Date	Event/Activity	Comments
2 February 2006	Meeting with DAEA & DWAF	
February 2006	Submission of DEAT Section 22 application and Plan of Study for Scoping to KZN DAEA.	
22 June 2006	Presentation of proposal to Richards Bay clean air association	Official Presentation
July 2006	Presentation to surrounding industry.	Overall support received. Main issue raised related to safety of pedestrians and employment
March 2007	Advert of EIA Notification appears in the Zululand Observer	Appendix A
March 2007	Knock and drop to surrounding I&APss	Appendix B
June 2007	Scoping Report submitted to the I&AP's And DWAF and DAEA	
June 2007	Registered I&AP's notified of availability of Scoping Report.	A 14 day comment period has been allowed and the comments received will be forwarded to the DAEA assessing officer.

E.2. Summary of the comments received:

It must be noted that up to now only one comment was received from an independent entity as a result of the advert in the "The Zululand Observer" that being the interest to purchase carbon credits. To date no other formal comments have been received from stakeholders.

However, the following issues have been raised by the stakeholders:

- Waste disposal
- Employment
- Health and safety
- Purchase of carbon credits

[14] Alton Landfill CDM Scoping Report EIA/6402, from Geomeasure Group – Groundwater & Environmental Consultants, page 7

Issue	Raised by	Description of Issue
Social		
Waste Disposal	Geomeasure Group	There is a possibility that fuels and other materials will be stored on site. Should these materials and waste produced during the construction phase there is a potential that they could have an impact on the receiving environment.
Visual impacts	Geomeasure Group	Any development has the potential to change the landscape and hence changes the visual aesthetics of a place.
Employment	Community	The community expressed their concerned with potential employment opportunities related to the development and the importation of migrant labour.
Noise	Geomeasure Group	There will be a potential of noise impacts from the construction activities.
Environmental		
Solid Waste	Geomeasure Group	Poor solid waste management on site can result in negative impacts and off site.
Dust	Geomeasure Group	Due to exposure of areas of soil to wind and vehicle movements, dust could become a negative impact during construction only.
Noise	Geomeasure Group	Noise levels will increase during the construction phase of the project and here will be a potential of noise impacts from the Taxi Rank during early morning peak hour and early evening peak.

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

As indicated in Section E.2 above, there have been no further formal comments submitted by any of the stakeholders regarding this project.

During the public events the above named issues were addressed by the Project Developer and by the participating Departments such as DAEA and DWAF.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Project developer:

Organization:	ENER·G Systems uMhlathuze (PTY) Ltd.
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Postfix/ZIP:	
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URL:	
Represented by:	
Title:	Mr
Salutation:	
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Middle Name:	James
First Name:	David
Department:	+27 83 447 5153
Mobile:	As above
Direct FAX:	As above
Direct tel:	
Personal E-Mail:	davidb@gessa.co.za

Project Annex 1 participant:

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State/Region:	
Postfix/ZIP:	2
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E-Mail:	ireland@ecosecurities.com
URL:	www.ecosecurities.com
Represented by:	
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Salutation:	Dr.
Last Name:	Moura Costa
Middle Name:	
First Name:	Pedro
Mobile:	
Direct FAX:	
Direct tel:	44 1865 202 635
Personal E-Mail:	cdm@ecosecurities.com

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

This project will not receive any public funding.

Annex 3

BASELINE INFORMATION

[redacted]

Electricity generation parameters	
Internal project demand (kW)	30
Load Factor project facilities	100%
Number hrs per year	8760
Conversion MW/KW	0.001
Elimp (MWh/yr)	262.8
Installed capacity (MW)	0.4
Load Factor	91%
Operational Hours/year	7972
Gross Electricity Generation (MWh/yr)	3189
Elimp (MWh/yr)	263
Net Electricity (MWh/yr)	2926

CER calculation – Baseline emissions from calculator

BASELINE EMISSIONS

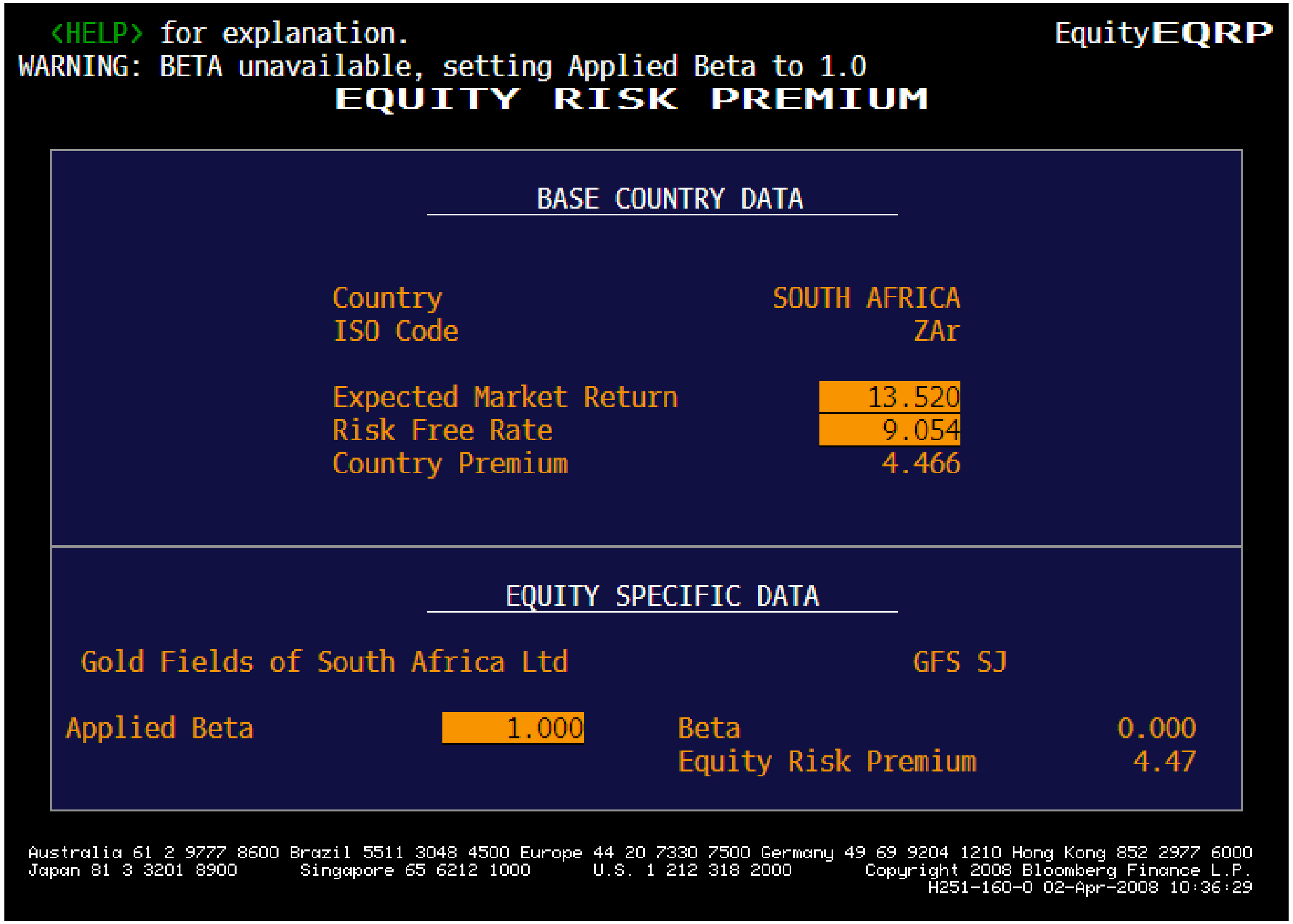
		WASTE STREAM																					
		First Type		Second Type		Third Type		Fourth Type		Fith Type		Sixth Type											
Year (x)	Total Amount	Amount	W_{jx} * DOC_j	Amount	W_{jx} * DOC_j	Amount	W_{jx} * DOC_j	Amount	W_{jx} * DOC_j	Amount	W_{jx} * DOC_j	Amount	W_{jx} * DOC_j	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
1982	41,456	0	0	4,772	1,909	3,180	477	0	0	16,417	3,283	7,951	0	268	247	228	210	194	179	166	153	142	131
1983	42,519	0	0	4,894	1,958	3,261	489	0	0	16,838	3,368	8,155	0	298	275	253	234	216	199	184	170	157	146
1984	43,609	0	0	5,019	2,008	3,345	502	0	0	17,269	3,454	8,364	0	332	306	282	260	240	221	204	189	174	161
1985	44,727	0	0	5,148	2,059	3,431	515	0	0	17,712	3,542	8,579	0	370	340	313	289	266	246	227	209	194	179
1986	45,874	0	0	5,280	2,112	3,519	528	0	0	18,166	3,633	8,799	0	412	379	349	321	296	273	252	233	215	199
1987	47,051	0	0	5,416	2,166	3,609	541	0	0	18,632	3,726	9,024	0	460	423	389	358	330	304	280	258	239	220
1988	48,257	0	0	5,554	2,222	3,701	555	0	0	19,110	3,822	9,256	0	513	472	434	399	367	338	312	287	265	245
1989	50,531	0	0	5,816	2,326	3,876	581	0	0	20,010	4,002	9,692	0	585	537	494	454	418	384	354	326	301	278
1990	52,912	0	0	6,090	2,436	4,058	609	0	0	20,953	4,191	10,149	0	668	613	563	517	475	437	403	371	342	315
1991	55,405	0	0	6,377	2,551	4,250	637	0	0	21,940	4,388	10,627	0	763	699	642	589	541	498	458	422	388	358
1992	58,016	0	0	6,678	2,671	4,450	667	0	0	22,974	4,595	11,127	0	871	798	732	672	617	567	521	480	441	407
1993	60,750	0	0	6,992	2,797	4,659	699	0	0	24,057	4,811	11,652	0	996	912	836	767	704	646	594	546	502	462
1994	63,612	0	0	7,322	2,929	4,879	732	0	0	25,190	5,038	12,201	0	1,140	1,043	955	876	803	737	676	622	572	526
1995	66,610	0	0	7,667	3,067	5,109	766	0	0	26,377	5,275	12,776	0	1,306	1,194	1,093	1,000	917	841	771	708	651	598
1996	69,748	0	0	8,028	3,211	5,350	802	0	0	27,620	5,524	13,378	0	1,497	1,368	1,250	1,144	1,048	960	880	808	742	682
1997	73,035	0	0	8,406	3,363	5,602	840	0	0	28,922	5,784	14,008	0	1,718	1,568	1,432	1,309	1,198	1,097	1,005	922	846	777
1998	86,946	0	0	10,008	4,003	6,669	1,000	0	0	34,431	6,886	16,676	0	2,243	2,045	1,867	1,705	1,559	1,426	1,306	1,197	1,097	1,007
1999	103,507	0	0	11,914	4,765	7,939	1,191	0	0	40,989	8,198	19,853	0	2,931	2,670	2,435	2,222	2,030	1,856	1,698	1,555	1,425	1,306
2000	123,223	0	0	14,183	5,673	9,451	1,418	0	0	48,796	9,759	23,634	0	3,834	3,489	3,179	2,898	2,645	2,416	2,209	2,021	1,851	1,696
2001	146,694	0	0	16,885	6,754	11,251	1,688	0	0	58,091	11,618	28,136	0	5,021	4,565	4,154	3,784	3,451	3,149	2,877	2,630	2,406	2,203
2002	174,636	0	0	20,101	8,040	13,395	2,009	0	0	69,156	13,831	33,495	0	6,582	5,977	5,434	4,945	4,505	4,108	3,749	3,425	3,131	2,865
2003	207,900	0	0	23,929	9,572	15,946	2,392	0	0	82,328	16,466	39,875	0	8,638	7,836	7,116	6,469	5,887	5,363	4,890	4,463	4,077	3,727
2004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2005	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2006	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2007	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2010	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	1,707,020	0		196,478		130,928		0		675,980		327,406		41,447	37,757	34,429	31,423	28,706	26,246	24,016	21,994	20,157	18,487

	Unit	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
BE *CH4, SWDS,y*	t CO2e	10362	37757	34429	31423	28706	26246	24016	21994	20157	18487	12725
BE *CH4, SWDS,y *0.9*	t CO2e	9326	33981	30986	28281	25835	23621	21615	19794	18141	16638	11453
PE electricity,y	t CO2e	61	245	245	245	245	245	245	245	245	245	184
ER LFG,y	t CO2e	9264	33737	30741	28036	25590	23377	21370	19550	17897	16394	11269
EGy	t CO2e	732	2926	2926	2926	2926	2926	2926	2926	2926	2926	2195
EFgrid	tCO2e/MWh	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
BE electricity$_y$	t CO2e	680	2721	2721	2721	2721	2721	2721	2721	2721	2721	2041
ER electricity,y	t CO2e	680	2721	2721	2721	2721	2721	2721	2721	2721	2721	2041
Total Baseline Emissions	t CO2e	10006	36702	33707	31002	28556	26342	24336	22515	20862	19359	13494
Total Emission Reductions	t CO2e	9945	36458	33462	30757	28312	26098	24091	22271	20618	19115	13310

Investment Analysis

Printout from internal database outlining country risk premium for South Africa

Note: The below is a printout from a database accessible through an agreement between EcoSecurities and Bloomberg. It was obtained through communications with the Help Desk at Bloomberg, using reference number GFS SJ EQUITY EQRP.



<HELP> for explanation. EquityEQRP

WARNING: BETA unavailable, setting Applied Beta to 1.0

EQUITY RISK PREMIUM

BASE COUNTRY DATA

Country	SOUTH AFRICA
ISO Code	ZAr
Expected Market Return	13.520
Risk Free Rate	9.054
Country Premium	4.466

EQUITY SPECIFIC DATA

Gold Fields of South Africa Ltd GFS SJ

Applied Beta	1.000	Beta	0.000
		Equity Risk Premium	4.47

Australia 61 2 9777 8600 Brazil 5511 3048 4500 Europe 44 20 7330 7500 Germany 49 69 9204 1210 Hong Kong 852 2977 6000
Japan 81 3 3201 8900 Singapore 65 6212 1000 U.S. 1 212 318 2000 Copyright 2008 Bloomberg Finance L.P.
H251-160-0 02-Apr-2008 10:36:29

Financial analysis and Sensitivity analysis

Please see attached Financial calculator.

Grid Emission Factor of the South African Electricity Grid (Please see attached Grid Emission Factor Calculator)

Plant name and type	Fuel	OM plant?	2004 BM plant? (1=yes)	2005 BM plant?	Date of commission	Licensed capacity (MW)	Net energy sent out MWh 2002	2003	2004	2005	Fossil fuel consumption (various units - see separate column) 2002	2003	2004	2005	Unit
Grand Total						43 034	204,511,108	219,198,686	226,393,919	226,346,226	173,221	178,408	184,716	187,998	
Eskom generation						39 810	196,067,796	210,218,785	217,919,213	217,754,872	93,823	96,460	104,370	109,898	
Coal fired stations		1				35 607	181,749,299	194,046,490	203,564,592	206,605,894	93,823	96,460	104,370	109,898	
Arnot	Coal	1			1971/09/21	1 980	11,974,764	14,135,237	13,032,188	11,798,514	5,595	5,799	6,655	6,609	kt
Camden	Coal	1		1	2005-2006	1 520				768,108	-	-	-	390	kt
Duvha	Coal	1			1980/01/18	3 450	23,320,444	21,384,335	25,450,613	25,034,970	10,560	10,682	9,989	11,908	kt
Grootvlei	Coal	1			1969/06/30	1 130				-	-	-	-	-	kt
Hendrina	Coal	1			1970/05/12	1 895	12,752,987	12,329,325	12,037,179	12,513,689	6,475	6,551	6,432	6,644	kt
Kendal	Coal	1			1988/10/01	3 840	26,006,905	27,820,202	27,005,053	26,897,931	13,518	14,156	15,746	15,430	kt
Komati	Coal	1			1969/06/30	891				-	-	-	-	-	kt
Kriel	Coal	1			1976/05/06	2 850	19,165,265	18,347,304	19,866,814	20,120,150	10,033	10,020	9,307	9,297	kt
Lethabo	Coal	1	1	1	1985/12/22	3 558	22,019,627	23,505,543	22,807,524	24,041,645	15,309	15,368	16,410	17,042	kt
Majuba	Coal	1	1	1	1996/04/01	3 843	4,600,976	10,015,560	12,539,663	17,170,166	2,593	2,370	5,539	6,363	kt
Matimba	Coal	1	1	1	1987/12/04	3 690	25,145,393	26,510,802	26,894,454	28,401,085	12,362	12,960	13,803	13,786	kt
Matla	Coal	1			1979/09/29	3 450	25,577,292	25,802,219	25,673,648	23,938,437	12,884	12,924	13,169	13,445	kt
Tutuka	Coal	1	1		1985/06/01	3 510	11,185,646	14,195,963	18,257,456	15,921,199	4,493	5,629	7,320	8,984	kt
Gas turbine stations		1				342	-	341	350	77,942					
Acacia	Kerosene	1			1976/05/13	171	0	299	305	47,848	7	18	43	17,488	kl = m3
PortRex	Kerosene	1			1976/09/30	171	0	42	45	30,094	1	106	17	10,999	kl = m3
Hydro power stations		-				661	2,356,753	777,041	777,041	725,360					
Gariep	Hydro	-			1971/09/08	360	1,164,640	383,991	383,991	402,432	-	-	-	-	
Vanderkloof	Hydro	-			1977/01/01	240	1,192,113	393,050	393,050	322,928	-	-	-	-	
Colleywobbles(Mbashe)	Hydro	-				42	-	-	-	-	-	-	-	-	
First Falls	Hydro	-				6	-	-	-	-	-	-	-	-	
Second Falls	Hydro	-				11	-	-	-	-	-	-	-	-	
Ncora	Hydro	-				2	-	-	-	-	-	-	-	-	
Nuclear stations		-				1 800	11,961,744	12,662,591	13,365,123	11,292,654					
Koeberg	Nuclear	-			1984/07/21	1 800	11,961,744	12,662,591	13,365,123	11,292,654	-	-	-	-	
Pumped-storage stations		1				1 400	-	2,732,322	212,107	(946,978)					
Drakensberg	Hydro	1			1981/06/17	1 000	-	1,787,554	-	-	-	-	-	-	
Palmiet	Hydro	1	1	1	1988/04/18	400	-	944,768	212,107	-	-	-	-	-	
Municipal generation						1 837	1,218,826	1,326,122	1,040,945	1,476,686	11,772	10,148	10,031	10,890	
Coal fired stations		1				1 323	1,201,006	1,038,433	1,027,337	1,110,036	11,685	10,104	9,996	10,800	
Athlone	Coal	1			n/a	180	76,596	76,596	10,230	(84)	745	745	100	(1)	TJ
Kroonstad	Coal	1				30					-	-	-	-	TJ
Swartkops	Coal	1				240					-	-	-	-	TJ
Bloemfontein	Coal	1			n/a	103	8,233	19,444	5,931	16,890	80	189	58	164	TJ
Orlando	Coal	1				300					-	-	-	-	TJ
Rooiwal	Coal	1			n/a	300	949,078	826,217	895,000	985,000	9,234	8,039	8,708	9,584	TJ
Pretoria West	Coal	1			n/a	170	167,099	116,176	116,176	108,230	1,626	1,130	1,130	1,053	TJ
Gas turbine stations		1				330	7,189	3,654	2,976	7,445	86	44	36	89	
Roggebaai	Kerosene	1			n/a	50	2,787	2,787	1,141	7,037	33	33	14	84	TJ
Athlone	Kerosene	1			n/a	40	867	867	1,827	229	10	10	22	3	TJ
Port Elizabeth	Kerosene	1			n/a	40	-	-	8	279	-	-	0	3	TJ
Johannesburg	Kerosene	1			n/a	176	3,535	-	-	(100)	42	-	-	(1)	TJ
Pretoria West	Kerosene	1				24					-	-	-	-	TJ
Hydro power stations		-				4	10,632	10,632	10,632	10,632	-	-	-	-	
Lydenburg	Hydro	-			n/a	2	6,000	6,000	6,000	6,000	-	-	-	-	
Ceres	Hydro	-			n/a	1	1,082	1,082	1,082	1,082	-	-	-	-	
Piet Retief	Hydro	-			n/a	1	3,550	3,550	3,550	3,550	-	-	-	-	
Pumped-storage stations		1				180	-	273,403	-	348,573	-	-	-	-	
Steenbras	Hydro	1			n/a	180	-	273,403	-	348,573	-	-	-	-	
Private generation						1 387	7,224,486	7,653,779	7,433,761	7,114,668	67,627	71,800	70,314	67,210	
Bagasse / coal fired stations		-				105	259,317	259,317	192,337	192,337	-	-	-	-	
Tongaat-Hulett Amatikulu	Bagasse-coal	-			n/a	12	26,781	26,781	26,781	26,781	(Assumed pure bagasse by conservativeness) => Fossil fuel consumption = zero				
Tongaat Hulett - Darnall	Bagasse-coal	-			n/a	12	21,704	21,704	21,704	21,704					
Tongaat Hulett - Felixton	Bagasse-coal	-			n/a	32	66,510	66,510	66,510	66,510					
Tongaat Hulett - Maidstone Mill	Bagasse-coal	-			n/a	29	67,397	67,397	67,397	67,397					
Transvaal Suiker Ltd	Bagasse-coal	-			n/a	20	76,925	76,925	9,945	9,945					
Coal fired stations		1				1 279	6,950,506	7,379,448	7,226,761	6,907,668	67,627	71,800	70,314	67,210	
Kelvin	Coal	1			n/a	540	1,721,353	1,721,353	1,568,666	1,568,666	16,748	16,748	15,263	15,263	TJ
Sasol Synth Fuels	Coal	1			n/a	600	4,421,074	4,738,677	4,738,677	4,606,484	43,016	46,106	46,106	44,820	TJ
Sasol Chem Ind	Coal	1			n/a	139	808,079	919,418	919,418	732,518	7,862	8,946	8,946	7,127	TJ
Hydro power stations		-				3	14,663	15,014	14,663	14,663	-	-	-	-	
Friedenheim	Hydro	-			n/a	3	14,663	15,014	14,663	14,663	-	-	-	-	

Calculation of fuel emission factors:				
	NCV GJ/t fuel	EF tCO2/TJ	Density t / m3	=> Emission factor
Coal	19.9	89.5		1.781 tCO2/t coal
Kerosene	42.4	70.8	0.804	2.414 tCO2/m3

Conversion factor:	277.78 MWh/TJ

Emission factors (tCO2/MWh)	**2004**	**2005**
OM	0.900	0.908
BM	0.950	0.951
CM	**0.925**	**0.930**

Sources and Assumptions made for the grid emission calculation

Sources:

1a/b/c/d. NERSA (2005/2006/2007/2008) Electricity supply statistics for South Africa 2002/2003/2004/2005 (brochures, with 2004 & 2005 electronic versions copied in tabs 1c, 1d)		
2. Eskom (2008) Website (http://www.eskom.co.za/live/content.php?Item_ID=4226)		
	%	i.e. MWhprod /TJcons
3a. Using CDM Tool default efficiency for old oil-fired gas turbines	30%	83.3
3b. Using CDM Tool default efficiency for old subcritical coal-fired plants	37%	102.8
4. IPCC (2006) Guidelines on National GHG Inventories, table 1.2 of Chapter 1 of Vol. 2 (Energy) Default values at the lower limit of the uncertainty at a 95% confidence interval		
5. Engineers Edge (2008) - See http://www.engineersedge.com/fluid_flow/fluid_data.htm		
Areas shaded: where net electricity sent out is negative, it is set to zero		

Note: White and grey cells are for calculations

Annex 4

MONITORING INFORMATION

All parameters will be monitored as stated in section B.7.