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

CONTENTS

Annexes

SECTION A. General description of small-scale project activity

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

Kanhym Farm manure to energy project

Version 03 in effect of 22 December 2006

Date of Completion :12 July 2007

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

Kanhym is the biggest pig farm in South Africa, home at any given time to approximately 46 000 pigs. In addition to the piggery the farm has various other agricultural divisions including a maize farming operation and a mill where maize is milled. Moreover, the farm is home to a large number of workers and dependents in two villages called Eikeboom and Thokoza. In Eikeboom there are 14 houses and in Thokoza 164. On average the occupancy in the houses is 4 people per home. The inhabitants get their electricity for free from Kanhym Farm and in turn Kanhym Farm buys the electricity from the South African grid directly from Eskom.

The pigs are confined to housed feeding lots with a sewer system that drains into a large, three-staged anaerobic lagoon with a firm crust at the top. The pigs defecate and urinate directly onto concrete floors. The manure is regularly washed with water that gravitates all manure into channels through which all matter gravitate into the main sewer channel terminating in the anaerobic lagoon. This currently unlined and uncovered lagoon produces a mixture of gasses including CH_4 (60%), N_2O (1%) and CO_2 (38%), all of which are released into the atmosphere. The proposal is to build a new lagoon upstream from the current one, line it with an impermeable membrane and seal it with an expandable membrane roof.

In Phase 1 of the project, the methane gas will destroyed by flaring it or burning it in a boiler. The boiler will be used to maintain the temperature in the new digester at 37 deg C. An enclosed flare, from a supplier that produces tried, tested and safe flaring technology will be installed. The burner technology in the boiler will be tried and tested technology ensuring safe and complete combustion. The amount of methane gas being produced will be monitored.

If sufficient gas is found to be produced and financial viability analysis allows it, Phase 2 of the project will entail the installation of a Jenbacher, Caterpillar, or Wartsila combustion gas engine co-generation genset. The biogas yield is projected to be 3,25 million NM_3/annum, which is sufficient to produce a continuous electrical supply of 1 MW of electricity at an efficiency of 40%. Engine waste heat will be used to heat the digester to the required temperature of 37 ° C, which will ensure predictable and optimal gas production. The GE Jenbacher/Caterpillar/Wartsila engines are tried and tested internationally and all three offer advanced and safe technology for converting methane rich gas into electricity. The electricity produced will be fed into the grid that presently supplies the farm and will probably be used to supply the residents of Eikeboom and/or Thokoza and/or the mill. Any surplus gas not absorbed by the engine due to surges or the engine being off for any reason, will be flared. The sludge/digestate (end product out of the digester) will be used as fertilizer and/or on soil enhancement in the area in an aerobic manner.

Contribution to sustainable development

By flaring the captured methane in Phase 1, greenhouse gas emissions will be reduced. If in Phase 2 electricity can be produced, further greenhouse gas emissions by the national grid will be avoided.

The project will improve the health situation at Kanhym farm by replacing the present anaerobic lagoon and its concomitant health and sanitary complexities with a covered anaerobic lagoon. The smell will also be improved.

The possibility of groundwater pollution by the present waste stream will be greatly reduced.

The project makes a contribution towards national economic development and the aims of the white papers on energy and renewable energy. In Phase 2, it will add to South Africa's energy supply, will add an Independent Power Producer, lead to energy diversification and create a source of renewable energy.

Given the size and prominence of Kanhym Pig farm in the South African Pork Industry, the project will have significant demonstration value regarding the positive effects of carbon finance on sustainable development.

The project will have a Black Economic Empowerment ("BEE") shareholding and BioTherm will lend the money to the BEE participants to purchase their shares and invest capital in the project.

A.3. Project participants:

Name of Party involved (*) ((host) indicates a host Party)	Private and/or public entity(ies) project participants (*) (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
South Africa (host)	BioTherm Energy SPV 1 (Pty) Ltd (Private entity) Project developer	No
The Netherlands	Statkraft Markets BV (Buyer of CER's)	No

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):

Republic of South Africa

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

Mpumalanga Province

A.4.1.3. City/Town/Community etc:

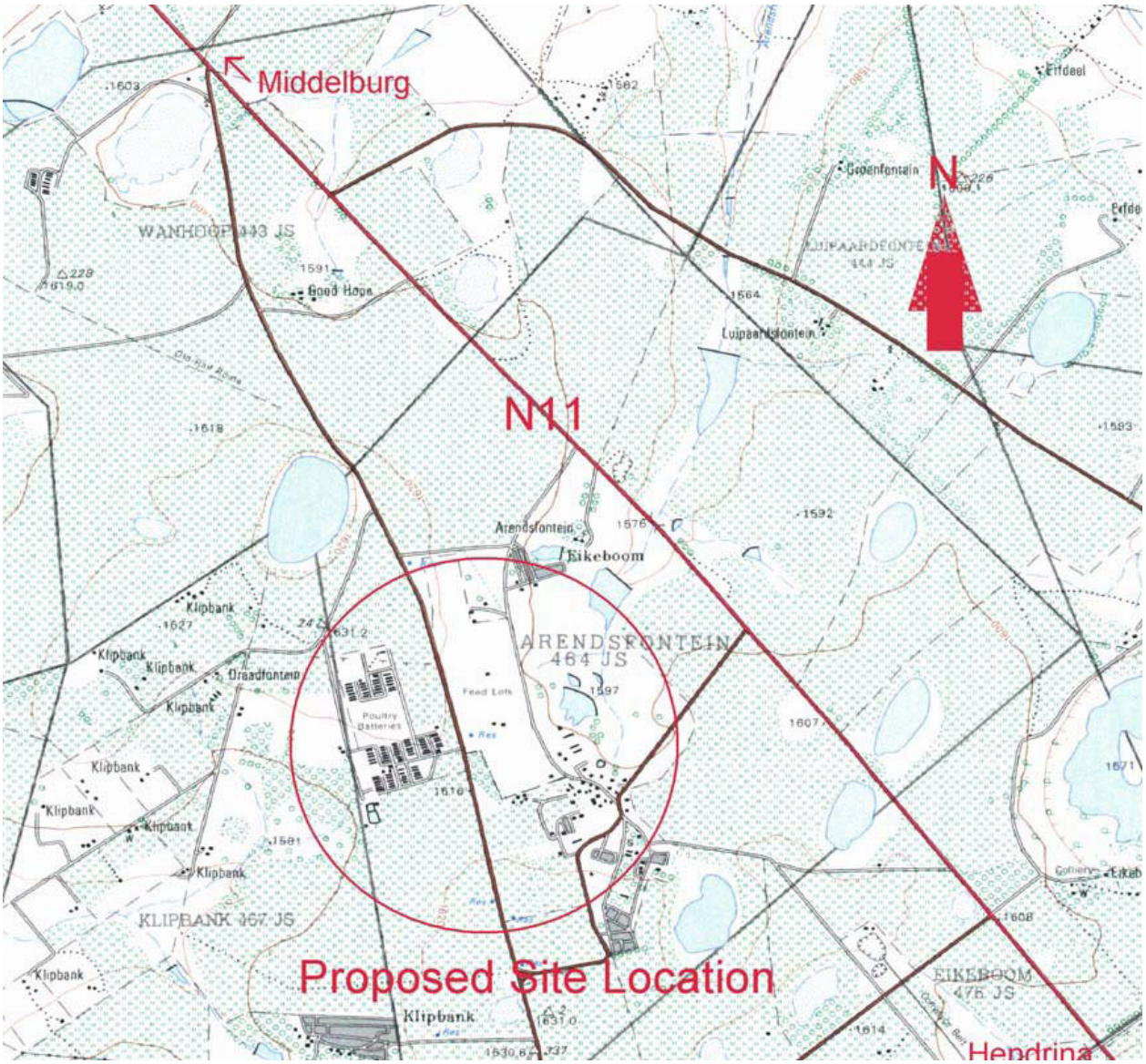
Middelburg

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

The proposed development site is located on the farm Driefontein 472 JS, which is approximately 9 459 hectares in extent. The farm is situated 32 km east of Witbank and 15 km south-south-east of the town of Middelburg in Mpumalanga, and falls within the jurisdiction of the Steve Tshwete Local Municipality (Nkangala District Municipality). Access to the farm is gained via the N11 highway between Middelburg and Hendrina. The full address is Kanhym Estates Piggery, Driehoek Farm, Middelburg, Mpumalanga, Republic of South Africa.

The GPS co-ordinates of the farm are as follows:

- 25 ° 89’ 50’’ S
- 29 ° 54’ 99’’ E



Driehoek Farm 472JS.

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

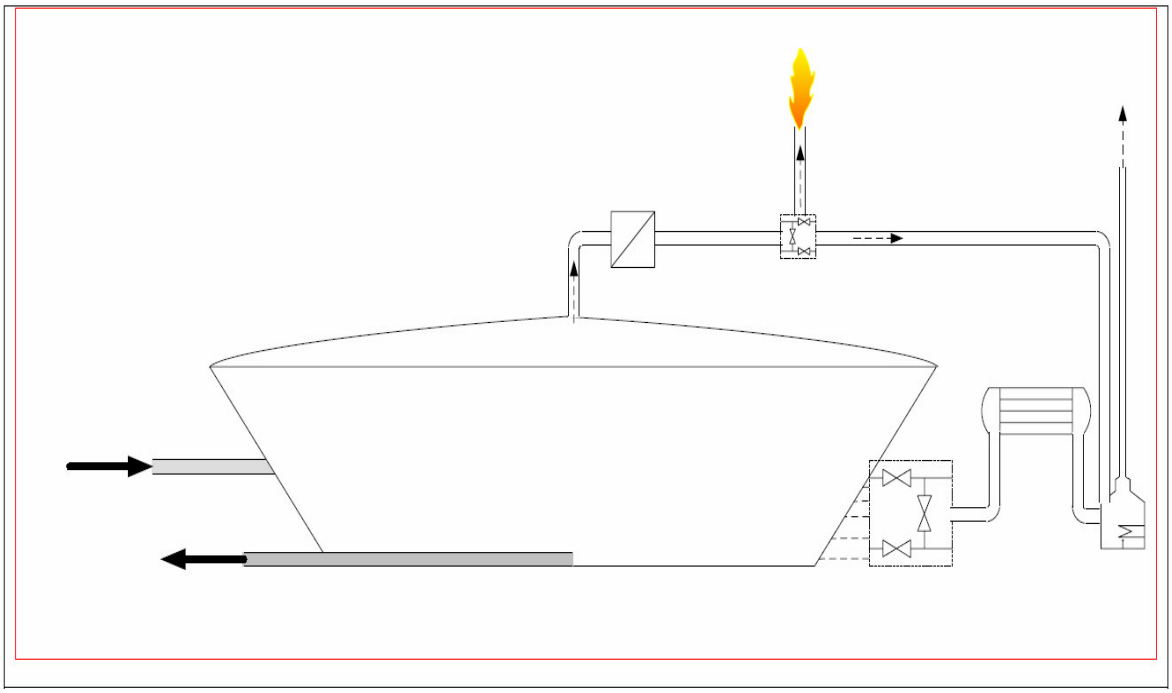
Phase 1

AMS III.D. Methane recovery in agricultural and agro industrial activities version 12 (valid from from 18/05/2007)

Technology/measure

The technological intervention is the construction of a new digester. This dam will be lined and covered with 1000 micron HDPE sheeting. The biogas will be drawn from digester through a blower. The gas will either be combusted in a boiler to heat the digester or if no heat is required it will be flared. For safety and monitoring purposes certain components will be placed on backup power supply for instance the blower, flare operation, gas measurement and computer operating system.

SCHEMATIC PORTRAYAL OF ANAEROBIC DIGESTER AND FLARE – PHASE 1



Phase 2

AMS 1.D Grid connected renewable electricity generation version 11 (valid from 18/05/07)

Technology/measure

After the gas production has been established and subject to financial viability an appropriately sized internal combustion type gas engine will be installed to run off the biogas. This engine should be in the

800 kW to 1500 kW range and will be sourced from a recognised supplier in the form of Caterpillar, Wartsila or GE Jenbacher. The gas handling system will be modified so that the gas is either flared or combusted in the engine. The engine exhaust gas will then be fed through the boiler for water heating purposes. Caterpillar, Wartsila and GE Jenbacher technology are all safe and sound and internationally tested technologies.

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

Because it is not certain that Phase 2 will be viable, the emissions reductions from Phase 2 have not been included. Should Phase 2 be viable and the capacity installed be conservatively estimated at 1 MW with a load factor of 85%, Phase 2 will add a further approximate 7,446 tonnes of CO_2e per annum depending on the grid emissions factor at the time. The figures below constitute the projected data for Phase 1 only. The final measured emissions reductions should be less than below at least in Phase 1 due to the flare efficiency assumption of 90% required by the methodology.

Years	Annual estimation of emission reductions in tonnes of CO_2e
2008	26 573
2009	26 573
2010	26 573
2011	26 573
2012	26 573
2013	26 573
2014	26 573
Total estimated reduction (tonnes of CO_2e)	186 011
Total number of crediting years	7
Annual average over the crediting period of estimated reductions (tonnes of CO_2e)	26 573

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

There is no public funding in the Project Activity.

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

There is no larger CDM project of which the present project is a debundled part or any part whatsoever.

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:

Phase 1:

AMS III.D. Methane recovery in agricultural and agro industrial activities version 12 (valid from 18/05/2007)

Phase 2

AMS 1.D Grid connected renewable electricity generation version 11 (valid from 18/05/07)

Reference in both cases: - www.unfccc.int

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

Phase 1

AMS III.D. Methane recovery in agricultural and agro industrial activities version 12 (valid from 18/05/07)

The eligibility criteria of the methodology are as follows*:*

1. This project category comprises methane recovery and destruction from manure and wastes from agricultural or agro-industrial activities that would be decaying anaerobically in the absence of the project activity by
(a) Installing methane recovery and combustion system to an existing source of methane emissions, or
(b) Changing the management practice of a biogenic waste or raw material in order to achieve the controlled anaerobic digestion equipped with methane recovery and combustion system.
2. The project activity shall satisfy the following conditions:
(a) The sludge must be handled aerobically. In case of soil application of the final sludge the proper conditions and procedures (not resulting in methane emissions) must be ensured.
(b) Technical measures shall be used (e.g. flared, combusted) to ensure that all biogas produced by the digester is used or flared.
3……..
4. Measures are limited to those that result in emission reductions of less than or equal to 60 kt CO_2 equivalent annually.

At present the waste from the piggery at Kanhym is sent through a separator where sawdust is separated out and thereafter pumped into a three staged anaerobic lagoon. It is submitted that the present instance the Project Activity comprises the installation of a methane recovery and combustion system to an existing source of methane as envisioned by category 1(a) above, in accordance with the approved small scale methodology III.D.

The design of the plant will ensure that all biogas is flared or combusted in a boiler in Phase 1 and combusted in the engine in Phase 2. The design will further ensure that any gas that cannot be combusted in the engine in Phase 2 for whatever reason will be flared as it was in Phase 1. In Phase 2 the exhaust gas from the engine will be put through the boiler so that combustion will only take place in the engine or the flare. The gas will be continuously monitored for flow, pressure, temperature and methane content. The flare and the boiler will also be monitored for combustion temperatures. The engine performance is also continously monitored to ensure complete combustion.

Regarding the requirement that sludge be treated aerobically, the project will apply sludge aerobically as fertilizer for and/or on soil enhancement in the area. Sludge treatment will be recorded as and when it occurs.

Photos of anaerobic lagoon at Letaba Estates showing height of dam wall and firm upper crust leading to anaerobic conditions

If electricity can viably be generated in Phase 2, the emission reduction will be claimed under the corresponding Type I Project Activity as prescribed above.

The emissions reduction in Phase 1 is projected to be in the order of at most 30 kt per annum, well under the limit of 60 kt per annum prescribed above.

In the baseline scenario the methane produced by the anaerobic lagoon is vented to atmosphere. In the Project Activity the methane will be recovered and in Phase 1 destroyed by flare combustion.

Phase 2

AMS 1.D Grid connected renewable electricity generation version 11 (valid from 18/05/07)

Phase 2 of the present project fits broadly under the category "Type (i) project activities: renewable energy project activities with a maximum output capacity equivalent to up to 15 megawatts (decision 17/CP.7, paragraph 6 (c) (i))" and more particularly under the approved small-scale methodology AMS-1.D. "Grid connected renewable electricity generation version 11". The project will generate a maximum of 1,5 MW electricity from the combustion of methane recovered from the anaerobic lagoon.

AMS 1.D has inter alia the following eligibility criteria:

> "This category comprises renewable energy generation units, such as photovoltaics, hydro, tidal/wave, wind, geothermal and renewable biomass, that supply electricity to and/or displace electricity from an electricity distribution system that is or would have been supplied by at least one fossil fuel fired generating unit."

In considering the chosen category and the title "Grid connected renewable electricity generation" the first consideration is that indeed the energy is renewable and it is being generated for a grid. The grid is the South African grid to which Kanhym farm is connected. The electricity displaced will be grid electricity. Furthermore the capacity of the project activity is projected to be at most 1,5 MW, well below the 15MW threshold and thus eligible as a small-scale CDM activity. The feedstock cannot increase and so the Project Activity will never go beyond 15MW.

It is thus submitted that the Project Activity complies in all respects with the requirements to use AMS I.D.

In the baseline scenario the electricity used on Kanhym farm is produced by the South African grid. It is assumed that in the absence of the Project Activity, this would continue into the future. It is further assumed that the emissions from combusting the methane in the GE Jenbacher/Caterpillar/Wartsila engine will be the same as the emissions generated by flaring the methane gas.

The emissions generated in the baseline scenario is calculated in accordance with paragraph 9(b) of AMS-1.D, being:

"The weighted average emissions (in kg CO2equ/kWh) of the current generation mix".

The Eskom 2006 annual report relates this figure as 0,978 kg/kWh (page 175).

The data of the year in which project generation will be used. It is anticipated that the grid emissions factor will increase in the next few years, as:

- Eskom, the national utility, is presently bringing three previously moth-balled, coal-fired power stations back online. The three stations (Arnot, Komati and Camden) have installed capacity of 2 100, 1 000 and 1 600 MW respectively (aggregate 4 700MW) and will further increase the proportion of grid electricity derived from fossil fuels;

- The renewable energy projects due to come on-stream in the next few years (Darling Wind Farm, Bethlehem hydro and possibly some others) are unlikely to even approach 100 MW of installed capacity in a national grid of approximately 42 000 MW installed capacity (0,23%);

- Eskom plans to ease pressure on capacity during peak hours by installing 1 000 MW of kerosene fired open cycle turbines. This process is under way.

Data/information	**Value**	**Source**
Grid emissions factor	0,978 kg/kWh	Eskom Annual Report 2006 p 175

B.3. Description of the project boundary:

Phase 1: AMS III.D. Methane recovery in agricultural and agro industrial activities version 12

The methodology prescribes that the project boundary will be "the physical, geographical site of the methane recovery facility". This encompasses the digester and all the equipment for the storage and transport of the methane inside the Kanhym Farm facility.

Phase 2

AMS 1.D Grid Connected Renewable Electricity Generation Version 11

The methodology prescribes that the project boundary will be physical, geographical site of the renewable generation source. In the present case that will be, should Phase 2 go ahead, the small shed/purpose built room/container within which the engine and genset are housed.

B.4. Description of baseline and its development:

The status quo for more than a decade at Kanhym farm has been to pump the sewerage into a dry dam and vent the methane gas that is anaerobically generated to the atmosphere. In the absence of carbon income there is no financial incentive for Kanhym Farm to change this practice to one where methane is recovered and destroyed. There is no legislation nor policy in South Africa that would compel Kanhym farm to recover and destroy methane gas emanating from its dry dams.

There are thus only two possible scenarios:

- Continuation of the status quo;
- Recovery and destruction of methane and (if gas yields allow this to be viable) the generation of electricity as a second phase.

The baseline in the absence of carbon finance would be the continuation of the status quo.

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:

This section will be completed with reference to the latest version of the **Tool for the demonstration and assessment of additionality.**

Step 1 (a) Identification of alternatives to the project activity consistent with current laws and Regulations:

The alternatives are:

- Continuation of the status quo
- The Project Activity without carbon income;
- Phase 1 and 2 built concurrently without carbon income

Step 1b: Consistency with mandatory laws and regulations

There are no laws in South Africa or in the Mpumalanga Province compelling Kanhym Farm to capture and destroy the methane produced by its anaerobic lagoon. Consequently, all three alternatives above and also the Project Activity are legally compliant and are realistic and credible alternatives.

Step 2: Benchmark analysis

Step 2a: Determine appropriate analysis method

Sub-step 2b: Option I: Apply simple cost analysis

The project in renders no economic benefits except CER income and thus is not financially attractive. No economic benefit can be shown without carbon income.

Phase 1 and 2 if developed simultaneously shows a sizeable negative return without carbon finance but for the sake of correctness will be dealt with separately below under the benchmark analysis as there is a potential economic benefit in the form of electricity savings.

Phase 1 and 2 together: Sub-step 2b Option III: Apply benchmark analysis

Assumptions and facts

- Lending rate: Average interest rate on loans provided by The Development Bank of Southern Africa is 10%. Lending margins on commercial limited recourse borrowing facilities are in the range of 2%-3%. A lending rate of 12% was used.
- Discount Rate for NPV calculation: 10%
- ZAR : € exchange rate: 9.5
- Loan duration: 7 years
- Deposit rate: - 6%
- Inflation: average of 6 % based on historical data.
- Project duration: 7 years
- Tariffs: Prevailing Eskom electricity tariffs
- Costs: taken into account are associated operational expenses (mainly contractually determined long term operation and maintenance, labour and finance costs)

The IRR on equity is negative and the NPV for the project is - R14,994,000 .

Sensitivity Analysis

By increasing the electricity tariff by an unachievable 10% continuously and decreasing capital by 20% the Equity IRR remains negative and the Project NPV is - R12,554,000

Step 4 Common practice analysis

There is to the knowledge of the proponent no pig farm in South Africa that captures and destroys methane. There is no financial return from doing so. There are thus no comparable activities as the project will be a first for South Africa. In this respect reference is made to the expert report of Jacobus Hoffman attached hereto as Annexure 6.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

PHASE 1

The food recipe at Kanhym Estates is highly regulated. The genetic make-up of the pigs at Kanhym together with their diet most closely resembles typical facilities in the United States. More detail about genetic make-up and diet appears in the expert report of Jacobus Hoffman.

The following values were used in the calculations:

Variable/Value	Indicated by which abbreviation	Value chosen	Unit	Reason for choice of value
Annual CH4 emission factor for livestock category *T*,	$EF_{(T)}$	N.a.	kg CH_4/animal/yr	To be calculated in accordance with methodology, not chosen
Daily volatile solid excreted for livestock category *T*,	$VS_{(T)}$	N.a.	kg dry matter/animal/ day	To be calculated in accordance with methodology, not chosen
Basis for calculating annual VS production, days/year	N.a.	365	N.a.	IPCC default
Maximum methane producing capacity for manure produced by	$Bo_{(T)}$		M^3 CH4/kg of VS excreted	To be calculated in accordance with methodology, not chosen

livestock category *T*				
Volatile solid excretion per day on a dry-organic matter basis,	VS		kg VS day-1	To be calculated in accordance with methodology, not chosen
Gross energy intake,	GE		MJ/day	Calculated from site data
Digestibility of the feed in percent	DE%	75	%	Food technologist
Urinary energy expressed as fraction of GE.	UE	.02	Fraction of GE	Default
The ash content of manure calculated	ASH	0.0251	Fraction	Food recipe
Methane Correction Factor	MCF_{SK}	0,76		Table 10.17 – open anaerobic lagoon at ave temperature of 17 deg C
Average annual temperature		17	Degrees Centigrade	Witbank weather station 1997-2006 data
Methane generation potential of manure	B_0	0,48	N.a.	USA value from Table 10A-8 and expert report of Jacobus Hoffman
Percentage manure handled in the system	MS	100	%	All manure is handled within concrete channels to the lagoon
Energy Density of feed	ED	17.5	MJ/kg	Site data
Conversion factor for dietary GE per kg of dry matter.	N.a.	18.45	MJ/kg dry matter	
Number of meat pigs at Kanhym Estates	N.a.	46 000	Head count	Actual figures (historical)
Food intake per annum	N.a.	tonnes per annum	21,405	Actual figures (historical)

The emission reduction achieved by the project activity will be the difference between the baseline emissions and the sum of the project emissions and leakage.

$ERy = BEy – (PEy + Leakage_y)$

Baseline emissions:

As stated above, in the baseline there is an anaerobic lagoon where sludge is treated anaerobically without methane recovery and combustion.

GE = Annual Food Intake / 365 * ED
= 21,405/365*17.5
= 1,026,267 MJ/day

Vs = (GE*(1-DE/100)+(UE*GE))*(1-Ash/18.45)

= (1,026,267*(1-0,75))+(0.02*1,026,267))*((1-0.0251)/18,45)
= 14,641 kg/day

$\mathbf{EF_T = (VS_T*365)*[Bo_{(T)}*0,67kg/m^3*\sum \underline{MCF_{SK}/100*MS_{TSk}}}$

= 14,641*365)*[0,48*0,67*(0,76/100*100)

= 1,306,162 kg/annum

$\underline{\mathbf{BE_y}}$ $\mathbf{= EF_{T*} GWP_{CH4} / 1000}$
= 1,306,162*21/1000
= 27,429 ton CO2e

Project emissions and leakage

Projected emissions reductions Phase 1:

It is predicted that there will be a nett increase in electricity usage of 100 kW as a result of the project.

Leakage = 100 (kWelec) * 8760 (hours/annum) * 0.978 (grid emission factor)
= 857 ton CO_2e per annum

ERy = BEy – (PEy + Leakage)

= 27,429 – 857

= 26,573

PHASE 2

Variable	Indicated by which abbreviation	Value chosen	Unit	Reason for choice of value
Grid emissions factor	GEFy	0,978	Kg/kWh	Published figure as indicated by the methodology
Load factor engine	LFEy	85	%	Conservative estimate
Size of engine that can be supported by gas yield	SEy	1	MWe	Conservative estimate
Hours in year y	Hy	8760	hours	Constant

The kiloWatthours (kWhy) produced in year y are projected to be the size of engine installed multiplied by the total number of hours in a year multiplied by the projected load factor.

MWhy = SEy*Hy * LFEy

= 1*8,760*0,85
= 7,446

According to paragraph 9(b) of the methodology the baseline is the weighted average emissions (in kg CO_2e/kWh) of the current generation mix. The emissions reduction is thus determined by the number of kiloWatthours generated, multiplied by the grid emissions factor. Seeing that the energy generating equipment will be new and will not be transferred from another activity no leakage is to be considered.

ERy = MWhy * GEFy
= 7,446 * 0,978
= 7,282 ton CO_2e/annum

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

Data / Parameter:	Qy,ww
Data unit:	m^3
Description:	Volume of wastewater treated in the year "y"
Source of data used:	Project Developer
Value applied:	584,000
Justification of the choice of data or description of measurement methods and procedures	Measured by Martin Kruse and Wim Maaskant

actually applied :	
Any comment:	Emission reductions will be monitored ex post through the volume of gas combusted and this value is thus indicative of what may be expected

B.6.3 Ex-ante calculation of emission reductions:

The calculation appears in section B.6.1 above. It can be summarised as follows:

Emissions reductions phase 1:

ERy = BEy – (PEy + Leakage)

= 27,429 – 856

= 26,573 tonnes CO_2e per annum

It is not certain whether Phase 2 will proceed but if it done and on a conservative estimation of gas yield (sufficient to support an 1 MW engine at an 85% load factor), Phase 2 might produce the following emissions reductions per annum for a period of 7 years:

ERy = MWhy * GEFy
= 7,446 * 0,978
= 7,282 ton CO2

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

The calculation appears in section B.6.1 above.

Emissions reductions phase 1:

ERy = BEy – (PEy + Leakage)

= 27,429 – 856

= 26,573 tonnes CO2 per annum

Emissions reductions phase 2:

As stated above the viability of phase 2 is not certain and the potential emissions reductions are thus omitted for purposes of hereof. Should phase 2 proceed according to the assumptions in B.1 above, the additional emissions reduction possible would be as follows:

ERy = MWhy * GEFy
= 7,446 * 0,978

= 7,282 ton CO2

Year	Estimation of project activity emissions (tonnes of CO2 e)	Estimation of baseline emissions (tonnes of CO2 e)	Estimation of leakage (tonnes of CO2 e)	Estimation of overall emission reductions (tonnes of CO2
2008	856	27 429	0	26 573
2009	856	27 429	0	26 573
2010	856	27 429	0	26 573
2011	856	27 429	0	26 573
2012	856	27 429	0	26 573
2013	856	27 429	0	26 573
2014	856	27 429	0	26 573
Total (tonnes of CO2 e)	5 992	192 003	0	186 011

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

Phase 1

Paragraphs 10 and 11 of AMS III.D require the following:

> *"10. Emission reductions achieved by the project activity in each year will be assessed ex-post through direct measurement of the amount of methane fuelled or flared. The maximal emission reduction in any year is limited to the yearly methane generation potential calculated in the project design document for that year.*
> *11. The amount of methane recovered and fuelled or flared shall be monitored ex-post, using flow meters. The fraction of methane in the biogas should be measured with a continuous analyser or, alternatively, with periodical measurements at a 95% confidence level. Temperature and pressure of the biogas are required to determine the density of methane combusted."*

In Phase 1, methane recovered will be combusted. This will be monitored by (as prescribed) by using continuous flow meters. The fraction of methane in the gas shall be measured with a continuous analyser. The temperature and pressure of the gas will be measured in order to establish the density of methane combusted. All data will be stored electronically.

B.7.1 Data and parameters monitored:

(Copy this table for each data and parameter)

Data / Parameter:	mathematical symbol for variable x,y,or z
Data unit:	nm^3

Description:	Methane recovered and flared
Source of data to be used:	Continuous analyser, pressure meter, temperature meter, flow meter
Value of data	The expected value was calculated using sampling values taken by the Project Developer
Description of measurement methods and procedures to be applied:	All data will be monitored continuously and registered in monthly reports that will be kept for the crediting period plus two years.
QA/QC procedures to be applied:	All meters will be calibrated in accordance with the manufacturer's specifications. The default flare efficiency level of 90% as per par 12 of the methodology and a 90% boiler burner efficiency level will be used for as long as phase 2 is not implemented. If installed equipment in phase 2 technically allows this the actual combustion efficiency will be used in phase 2 to determine methane destruction while a 90% efficiency will be assumed should the equipment not technically allow the monitoring of actual methane destruction by combustion in the engine.
Any comment:	This calculation will establish the baseline from which the project emissions will be subtracted to determine the emissions reduction.

B.7.1 Data and parameters monitored:	
(Copy this table for each data and parameter)	
Data / Parameter:	kWhy
Data unit:	kWh/annum
Description:	Electricity used by Project Activity
Source of data to be used:	Electricity meter
Value of data	The expected value is 100kW at a load factor of 100% (conservative as this lowers CER's) multiplied by the grid emissions factor at the time (presently 0,978 kg/kWh
Description of measurement methods and procedures to be applied:	A continuous electricity meter will be installed – data will be logged and stored electronically and continuously and registered in monthly reports that will be kept for the crediting period plus two years.
QA/QC procedures to be applied:	The meter will be calibrated in accordance with the manufacturer's specifications
Any comment:	

B.7.1 Data and parameters monitored:	
(Copy this table for each data and parameter)	
Data / Parameter:	
Data unit:	kg/kWh
Description:	Grid emissions factor in year "y"
Source of data to be used:	Eskom annual report

Value of data	The most recent value of 0,978 was used
Description of measurement methods and procedures to be applied:	Not applicable
QA/QC procedures to be applied:	Not applicable
Any comment:	This value will be multiplied by the installed equipment value mentioned above to determine project activity emissions from power usage. The same value will be needed to calculate the baseline should phase 2 proceed – this description will thus also apply below when phase 2 is discussed but will not be repeated there.

B.7.1 Data and parameters monitored:	
(Copy this table for each data and parameter)	
Data / Parameter:	**$PE_{y,s,final}$**
Data unit:	Tonnes/annum
Description:	Emissions from anaerobic decay of the final sludge produced in the year "y".
Source of data to be used:	Project developer reports on final application of sludge
Value of data	Expected at zero as sludge will be land applied
Description of measurement methods and procedures to be applied:	Not applicable but final sludge application will be monitored
QA/QC procedures to be applied:	Not applicable
Any comment:	In terms of paragraph 5(v) of the methodology "*If the sludge is …..used for soil application, this term can be neglected, and the final disposal of the sludge shall be monitored during the crediting period*".

B.7.1 Data and parameters monitored:	
(Copy this table for each data and parameter)	
Data / Parameter:	Average temperature
Data unit:	Degrees Centigrade
Description:	Determinant of baseline
Source of data to be used:	Witbank weather station
Value of data	Expected at 17,1 degrees as per 10 year average 1997-2006
Description of measurement methods and procedures to be applied:	Published data will be used

QA/QC procedures to be applied:	Official public data from SA Weather Bureau will be used
Any comment:	

Phase 2

If Phase 2 proceeds, the following data will be monitored. The grid emissions factor has already been dealt with above.

B.7.1 Data and parameters monitored:	
(Copy this table for each data and parameter)	
Data / Parameter:	kWhy
Data unit:	kWh/annum
Description:	Electricity produced by Project Activity
Source of data to be used:	Electricity meter
Value of data	A conservative projected value was calculated using a projected gas yield big enough to sustain an 1 MW engine at an 85% load factor.
Description of measurement methods and procedures to be applied:	A continuous electricity meter will be installed – data will be logged and stored electronically and continuously and registered in monthly reports that will be kept for the crediting period plus two years."
QA/QC procedures to be applied:	The meter will be calibrated in accordance with the manufacturer's specifications
Any comment:	

B.7.1 Data and parameters monitored:	
(Copy this table for each data and parameter)	
Data / Parameter:	Gas flow to engine
Data unit:	NM_3/annum
Description:	Electricity produced by Project Activity
Source of data to be used:	Electricity meter
Value of data	3,25 million per annum of which a projected 85% will be combusted and the remainder flared during periods when the engine is off line.
Description of measurement methods and procedures to be applied:	A continuous flow meter will be installed – data will be logged and stored electronically and continuously and registered in monthly reports that will be kept for the crediting period plus two years."
QA/QC procedures to be applied:	The meter will be calibrated in accordance with the manufacturer's specifications
Any comment:	

B.7.2 Description of the monitoring plan:

Phase 1

In phase 1, GHG reductions due to project activity are based on the methane emission reductions. The monitoring system mainly comprise of monitoring of the volume of biogas recovered and flared. The meters used in the system will be from industry standard with the best accuracy available. All instruments will be calibrated in accordance with the manufacturer's specifications and at regular intervals (if required) so that the accuracy of measurement can be ensured all the time. The calibration frequency too is a part of the monitoring and verification parameters. All measurements will be reported monthly in reports that will be kept for the crediting period plus two years.

The volume of biogas recovered from the anaerobic digester will be measured using a continuous on-line industry standard gas flow meter**.** The fraction of methane in the biogas will be measured using a continuous on-line gas analyser or alternatively by means of periodical measurements at a 95% confidence level in accredited laboratories. The frequency of testing will be reduced if there is no wide variation in the values or increased if there are wide variations in the values. Temperature and pressure of biogas will also be measured using on-line meters to determine the density of methane in the biogas.

The flare efficiency is defined as the fraction of time in which the gas is combusted in the flare, multiplied by the efficiency of the flaring process. For the purpose of the PDD CER estimates, an ex ante 90% efficiency is assumed. The flare device shall be maintained regularly to ensure optimal operation of the flare. Compliance with the manufacturers specification of the flare device (temperature, biogas flow rate) will be checked continuously.

The gas burners in the boiler will also be of high standard ensuring near perfect combustion. These will be maintained as per the suppliers specification to ensure optimum combustion. The combustion temperature in the boiler combustion chamber will be monitored similarly to the flare.

End-use of final sludge is monitored in the plant on a regular basis to prove that there would not be development of anaerobic conditions and thus methane generation.

Phase 2

In phase 2, electricity meters will monitor the electricity generated from the plant. A continuous electricity meter will be installed with data captured and registered in monthly reports that will be kept for the crediting period plus two years. The electricity meter will be calibrated in accordance with the manufacturer's specifications. The engine will be maintained as per the suppliers specification which will ensure optimal combustion conditions as per the engine supplier data sheets which will be better than the 90% combustion efficiency default that will be selected.

A monitoring team will make regular site audits to ensure that monitoring and operational procedures are being observed in accordance with the monitoring plan and monitoring protocol.

BioTherm SPV1 will subcontract or delegate an operations, maintenance, and monitoring service provider who will be responsible for monitoring biogas production and electricity generation as part of standard operating procedure for the project activity. Such service provider will be trained to ensure

accurate and effective operations, maintenance and monitoring e.g. equipment operation, data recording, reporting, and operation, calibration, maintenance, and emergency procedures.

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

Baseline study completed in July 2007 by Wim Maaskant of BGP Engineers and Martin Kruse of BioTherm Energy. Data captured by way of sampling was taken during December 2005 and February 2006.

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:

01/01/2008

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

The Project Activity will continue indefinitely while the projected total crediting period during which the Project Activity will qualify for CER's is 14 years 0 months.

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 or as soon thereafter as commissioning allows – starting date will be determined on first verification.

C.2.1.2. Length of the first crediting period:

7 years 0 months

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

Not applicable left open on purpose.

C.2.2.2. Length:

Not applicable left open on purpose.

SECTION D. Environmental impacts

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

In terms of the regulations to the Environment Conservation Act 73 of 1989 existing at the time it was required that an Environmental Impact Assessment ("EIA") be carried out. This was indeed done and a comprehensive report was compiled after a stakeholder process had been initiated and completed. This report is voluminous but available on request. The Executive Summary is attached hereto as Annexure 5.

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:

The potential impacts of the project are discussed in page 3-4 of the executive summary to the EIA attached hereto.

Potential positive impacts

The primary positive impacts resulting from the proposed project include the following:

- Reduction in harmful, GHG methane emissions. The methane gas which is currently released from the manure waste lagoon to atmosphere will be combusted.
- The farm's reliance on grid-sourced, fossil fuel derived energy could be reduced/eliminated resulting in reduction of upstream greenhouse gas emissions from thermal power generation.
- Reduction in odour impact from release of trace volumes of hydrogen sulphide, ammonia and volatile organics from the existing anaerobic lagoon. The gases will be combusted.
- Reduction/elimination of groundwater and surface water pollution from existing unlined lagoon.

If and when Phase 2 is implemented, the following additional benefits will occur:

- the renewable electricity produced will be introduced back into the local Kanhym grid. With two sources of electricity, Eskom power and the renewable electricity, the disruption caused by power cuts will be mitigated. This is particularly important for the operation of mills which take about three hours to clean-up and restart following a power cut.
- A total of 164 houses in Thokoza and 20 houses in Eikeboom and surroundings can potentially be supplied with green energy. With Eskom power as back-up, these houses' energy security will also be improved. The occupants presently get their electricity free of charge from Kanhym farm – this arrangement will persist.

Potential negative impacts

The primary negative impacts resulting from the proposed project include the following problematic issues, which will be addressed through engineering or site selection, have been identified as follows:

- Potential release of digester gas (methane) and resulting explosion. Preventative engineering controls will be incorporated into the design to limit this risk.
- Potential seepage from digester to groundwater resulting in contamination of groundwater. The lagoon will be lined with 1000µm HDPE lining and have a cut-off trench.

The management of supernate while important was outside of the direct scope of the Environmental Impact Assessment as it exists in the baseline, will persist in the Project Activity and is not affected by the Project Activity. However, numerous options have been put forward which should be evaluated in due course by Kanhym Estates in consultation with the relevant authorities.

SECTION E. Stakeholders' comments

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

A number of steps were taken to notify stakeholders and Interested and Affected Parties ("I&APs") of the proposed development, the EIA process and their opportunity to provide comments. Information was distributed to ensure that informed comments could be made.

Prior to the commencement of the public participation process that was part of the formal EIA, the proponent engaged the following people and institutions:

- The South African Climate Action Network (Ms. Elin Lorimer)
- All neighbours to the farm, both corporate and private (Christo Schoeman, Ben Muyburgh - Alzu Enterprises; Samson Hyman - SIS Farming Group; Dirk Uys / Awie Strauss; Arthur Sturgess; Div de Villiers - Middelburg Mine; Rubin Meyer - Optimum Colliery).
- The inhabitants of the two villages on the farm (Eikeboom and Thokoza)
- The town clerk of Middelburg, Mr Fouche.

It then appeared that a formal EIA process would need to be followed and the above steps were augmented as follows:

Newspaper advertisements, serving as a notification of the project and an invitation to register and participate, were placed in 'The Middelburg Observer' and 'The Star' on 14 July 2006. Two A2-size site notices were erected at the main entrance to the Kanhym Farm, and one at the Eikenhof Village east of the site on 14 July 2006.

In addition to the above, a Background Information Document (BID) was compiled for distribution upon request. A copy of the BID was provided to key stakeholders (The Department of Environmental Affairs and Tourism – "DEAT"`, The Department of` Water Affairs and Forestry – "DWAF" & the provincial authority Mpumalanga Department of Agriculture and Land Administration - "MDALA").

Stakeholders and I&APs were given 30 days to comment and/or raise issues of concern regarding the proposed development. The comment period expired on 14 August 2006. Due to the limited number and nature of replies received, a public meeting was not deemed necessary.

Authority meetings were held with DWAF and DEAT. Site visits were also conducted during which various aspects of the project and issues arising were debated.

E.2. Summary of the comments received:

Confirmation was received from all of the abovementioned neighbours that they do not object to the proposed project.

The South African Climate Action Network commented:

> *This project appears to take a good approach to meeting the Sustainable Development Criteria as far as we can see, without falsely claiming social benefits and with an admirable energy efficiency level compared to our current energy supply!*
>
> *We do have a brief question around the project description, where the PIN talks about the digestate being recirculated as sewer wash water or applied to the adjacent crops as fertilizer. There is just a bit of confusion as to why there seems to be uncertainty about simply applying all the digestate as fertilizer, as it seems that it could increase the productivity of the farm. Also, if the digestate is to be recirculated as sewer wash water, where is it being released to?*

Comments received from the village in Thokoza were generally positive. Several members expressed support for the project.

The Department of Water Affairs and Forestry ("DWAF") made inter alia the following comments during two meetings about the project:

- The waste must be classified and hazard rated;
- The lagoon will as a minimum require a 1mm HDPE lining;
- The dam must be registered in terms of the National Water Act: 1998 and the dam safety regulations (GNR 1560 of 25 July 1986);
- The broader issue of effluent disposal by Kanhym Farm as it has occurred for more than ten years was noted and it was accepted by DWAF that this was a matter to be resolved between Kanhym and the authorities as the Project Proponent has no direct impact on this;
- The proposed development is an improvement on the existing system and will be looked upon favourably by DWAF.

MDALA (Mpumalanga Department of Agriculture and Land Affairs) approved the EIA during July 2007.

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

The comments made by SACAN were very pertinent and the Project Developer together with environmental experts considered them carefully in coming to an optimum solution. The recirculation of the water to the so-called "varkdam" is part of the baseline and has been for more than a decade. The reason why all the digestate cannot be fertilised onto the lands is because the salinity of the digestate might make this hazardous unless it is done over an unviably large area.

All comments and requirements of DWAF were incorporated in the final project design and technical specifications.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	BioTherm SPV 1 (Pty) Ltd
Street/P.O.Box:	PO Box 98867
Building:	
City:	Sloane Park
State/Region:	Gauteng
Postfix/ZIP:	2152
Country:	South Africa
Telephone:	+27 11 361 1300
FAX:	+27 11 361 1301
E-Mail:	charles.liebenberg@wspgroup.com
URL:	Not applicable
Represented by:	CDM Africa Climate Solutions (Pty) Ltd
Title:	Mr
Salutation:	CEO
Last Name:	Van den Berg
Middle Name:	
First Name:	Johan
Department:	
Mobile:	+27 82 925 5680
Direct FAX:	+27 21 883 3474
Direct tel:	+27 21 883 3474
Personal E-Mail:	johanvdb@cdmafrica.com

Organization:	Statkraft Markets BV
Street/P.O.Box:	Gustav Mahlerplein 100
Building:	
City:	Amsterdam
State/Region:	
Postfix/ZIP:	1082 MA
Country:	The Netherlands
Telephone:	+31 20 795 7800
FAX:	+31 20 795 7899
E-Mail:	Peter.Sprengers@statkraft.nl
URL:	www.statkraft.com
Represented by:	Peter Sprengers
Title:	Carbon Business Analyst
Salutation:	Mr
Last Name:	Sprengers
Middle Name:	
First Name:	Peter
Department:	
Mobile:	+31 65 069 0312
Direct FAX:	+31 20 795 7899
Direct tel:	+31 20 295 7842
Personal E-Mail:	Peter.Sprengers@statkraft.nl

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

Not Applicable

Annex 3

BASELINE INFORMATION

Not Applicable. Information has been incorporated in the body of the document.

Annex 4

MONITORING INFORMATION

Not applicable. Monitoring information appears in the body of the document.

Annex 5

EXCERPT FROM ENVIRONMENTAL IMPACT ASSESSMENT

"2. EXECUTIVE SUMMARY

Environmental Impact Assessment aims to ensure effective compliance and governance concerning the environment, through identifying and focussing on relevant potential environmental impacts posed by development, assessing the significance of these impacts, and developing feasible mitigation measures and management plans to ensure development continues in a manner which is environmentally, socially and economically sustainable. Simultaneously, issues such as community rights, needs and empowerment are considered. The key objective is to provide concise, relevant and scientifically correct information and independent recommendations, so as to enable informed decision-making by authorities.

This Scoping and Environmental Impact Report was compiled accordingly, focussing firstly on the relevant aspects associated with the proposed Anaerobic Digester that may result in environmental impacts, and secondly considering current effluent treatment facilities on-site, and making recommendations on how these can be improved.

The focus of the EIA was the proposed Anaerobic Digestion System, as this is a new activity requiring authorisation. The main outcome of the proposed project, should it proceed, would be the reduction in greenhouse gas in the form of methane, which is currently released from existing, open anaerobic digestion ponds in an uncontrolled manner.

As a result of optimisation of the digestion process, the controlled collection of methane and the ultimate destruction thereof, the net impact of the proposed project would be positive compared with the current situation. However, achieving an overall benefit requires the consideration of a number of aspects, which if not managed adequately, may result in impacts on other media such as surface or groundwater. The following key aspects were therefore assessed in detail:

- Emissions to air, including efficiency of collection and flaring, possible explosion risks, and release of odours;
- Accumulation of digestate waste and effluent, hazard rating of waste, and re-use opportunities and constraints, focussing on application as fertiliser; and
- Potential risk of soil, surface and groundwater pollution.

The above aspects were evaluated in the impact assessment and feasible mitigation measures (design and operational) proposed as required. Mitigation measures were formulated for practical implementation and monitoring in an Environmental Management Plan.

It was concluded that the negative impacts directly associated with the installation and operation of the anaerobic digester, subsequent combustion of biogas and potential generation of electricity are not of a significant nature, provided that the EMP is adhered to, and would not make the project non-feasible. It was therefore concluded that the project be authorised due to the environmental and economic benefits of the proposed project, which would include:

- Reduction in global warming resulting from methane gas emissions. The methane gas which is currently released from the manure waste lagoon to atmosphere will be eliminated.
- Reduction/elimination of groundwater and surface water pollution from existing unlined settling ponds. At least two of the three unlined ponds will be discontinued.
- Reduction in odour impact from release of trace volumes of hydrogen sulphide, ammonia and volatile organics from the existing settling ponds. The gases will be combusted.
- Potential reduction in grid-sourced electricity derived from fossil fuelled power stations, thus resulting in reduction of upstream greenhouse gas emissions and environmental impacts associated with thermal power generation.

Although not normal practice, the report included an assessment of the current activities on-site. Although current effluent treatment at the site could be improved in several areas, the project as proposed would essentially not affect these activities, and could be seen and evaluated in isolation (i.e. 'black-box' approach). Notwithstanding, a number of recommendations have been made relating to investigations required at the site, including:

- Determining the overall capacity to deal with effluent generated;
- Assessing the environmental impact of current practices; and
- Assessing the risk of subsurface overflow and water quality deterioration due to increasing salt concentrations.

Some options to improve effluent management were identified for further consideration and evaluation based on the above studies and sustainability and cost benefit analysis (CBA).

These included:

- Recycling effluent to a smaller concrete holding dam to increase nutrient concentration for use in crop fertilisation or mine rehabilitation;
- Rotational fertilisation of a significant area of uncultivated land, coupled with large scale fertilisation of agricultural fields;
- Use of effluent as fertiliser through installation of a crop irrigation augmentation/ fertilisation system;
- Use of effluent to irrigate and simultaneously fertilise crops such as instant lawn or soya;
- Pumping the supernate effluent to the Middelburg treatment works;
- Treatment of the effluent using a reverse osmosis or conventional treatment plant; and
- Several options to recycle water back directly back to the piggery."

Annex 6

EXPERT REPORT OF JACOBUS HOFFMAN (SIGNED COPY AVAILABLE IN PDF FORMAT)

10 July 2007

STATEMENT ON PREALING PRACTICE IN PORK INDUSTRY IN SOUTH AFRICA AND GENETIC NATURE/FEEDING PRACTISES AT KANHYM FARM, MPUMALANGA, SOUTH AFRICA

I, the undersigned

JACOBUS JOHANNES HOFFMAN

have been approached by BioTherm Energy (Pty) Ltd to provide an expert report on the subjects mentioned in the heading above.

I am presently the General Manager at Premier Pork Producers (PPP) and have been in this fulltime position for more than three years. I have an intimate knowledge of the pork industry in South Africa in general and of the Kanhym Farm in particular. Kanhym has been a member of our association for a number of years.

I respectfully submit that I am in the position to give an opinion on the matters dealt with in this document.

Premier Pork Producers is the industry association responsible for all the Northern provinces in South Africa and by far the largest pork association in South Africa representing more than 50% of the pig farmers calculated on the amount of sows in the country.

As a producer based association, our functions include but are not limited to marketing / promotion activities, training, quality assurance systems, research, spokesman for the industry at various forums and government liaising. One of the functions of our association is to facilitate and enhance global market exposure and competitiveness for all our members by introducing them to current market trends and developments.

Kanhym farm

Kanhym is one of the biggest pig farm groups in South Africa and the largest single site production unit with more than 4000 sows. The company is the local representative of PIC International, the largest international pork genetics company with 25% of the world market based on technified sales. Kanhym has been certified by the South African Department of Agriculture as an Export ready compartment and

Premier Pork Producers Premier Varkvleis Produsente

Tel: +27 12 361-3920 | Fax: +27 12 361-4069 | Email: hoffman@sapork.com or info@sapork.com

is also in the process of implementing the industry quality assurance program administered and audited by PPP on a number of their farms.

The genetics used by Kanhym is the same as the PIC genetics used in the USA and the EU. The main lines would be the PIC Line 2 – Landrace, PIC Line 3 – Large White and the PIC Line 19 – White Duroc. On the Boar site the main lines used is the PIC Line 62 – Pietrain and PIC Line 65 – Synthetic Line.

Kanhym uses artificial insemination at a rate of more than 90%. The semen for the breeding farms is either imported from the USA or Canada.

Diet of pigs and B_0 default factor

The diet of the pigs at Kanhym has a maize and soya based ration, very similar to pork operations in the United States of America.

Pigs are placed on an accelerated growth programme in climate controlled housing and typically reach the live weight of +/- 105 kg within a period of 150 days.

The material dealing with tier 2 IPCC calculations for swine has been made available to me and for the reasons mentioned above, in my opinion, the correct "B_0"default factor to use would be the USA default factor appearing on page 80 of the PDF document.

Prevailing practice

Kanhym farm will be the first pig farm within our jurisdiction to recover and destroy methane from its manure effluent by way of an anaerobic digester and flare.

There are no laws or regulations forcing pig farms to capture and destroy methane in this manner.

Signed on this 10th day of July 2007 at Pretoria.

Jacobus Johannes Hoffman
GENERAL MANAGER

Premier Pork Producers Premier Varkvleis Produsente

Tel: +27 12 361-3920 | Fax: +27 12 361-4069 | Email: hoffman@sapork.com or info@sapork.com