PetroSA Biogas to Energy Plant
Monitoring Report

First monitoring period
1 Oct 2007 – 30 September 2008

CDM Registration number 0446

1 December 2008

1. Project Background

PetroSA Biogas to Energy Project was registered as a CDM Project by the UNFCCC on 29 September 2006 under reference number 0446 and has been commercially operational since 1 October 2007. The Project Design Document contains all the relevant background on the project and can be found on the UNFCCC website:

http://cdm.unfccc.int/Projects/DB/PriceWaterhouseCoopers1148482596.97/view

2. Monitoring Background

The calculation of emission reductions is based on methodology AMS-1.D. Grid connected renewable electricity generation (version 9). Emission reductions are achieved by replacement of fossil fuel based grid electricity with electricity produced from biogas. Monitoring is based only on continuous metering of electricity produced by the biogas. During the monitoring period the plant produced a total of 25,725.89 MWh of electricity. The monitoring methodology is detailed in section D of the PDD.

3. Monitoring Results

3.1 Emission reduction

The calculated emission reductions amount to 25,725.89 tonnes CO2eq

3.2 Monitoring period

The monitoring period is 1 October 2007 to 30 September 2008.

3.3 Calculation methodology

Emission reductions were calculated on the basis of the formulae detailed in Section E of the PDD.

The calculation entails the following:

- Net electricity produced by the project is recorded on a continuous basis and aggregated monthly
- Net electricity generated monthly is multiplied by the grid emissions factor as stated in the PDD to obtain the emission reductions for the project activity for the monitoring period
- Calculation of the emission reductions is based on parameters fixed in the PDD and justified during the validation
- The latest grid emission factor published by Eskom in their annual report for the period 1 April 2007 to 31 March 2008 is 1.00 kg/kWh.

3.4 Presentation of monitoring results

The monitoring results are annexed hereto as follows:

Appendix A: Summary of the monitoring results

Appendix B: Calculation of emission reductions as detailed in PDD

3.5 Supporting documentation

Appendix C: Monitoring equipment

Appendix D: Monitoring data

Appendix E: Internal audit procedures & procedures for corrective action

Appendix F: Plant management and operation

APPENDIX A Summary of monitoring results

Period	Days	[1]Total electricity generated by plant kWh	[2]Total electricity consumed by plant kWh	[3]Net electricity generated by plant *(1 - 2)* kWh	[4]Net electricity generated by plant *(3 ÷ 1000)* MWh	[5]Grid emissions factor kg/kWh	[6]Emission reductions *(3 x 5) / 1000* tonnes CO_2e
01/10/2007 - 31/10/2007	31	1794276.00	53655.30	1740620.70	1740.62	1.00	1740.62
01/11/2007 - 30/11/2007	30	1889820.00	60159.72	1829660.28	1829.66	1.00	1829.66
01/12/2007 - 31/12/2007	31	2348640.00	64135.86	2284504.14	2284.50	1.00	2284.50
01/01/2008 - 31/01/2008	31	1309212.00	44520.60	1264691.40	1264.69	1.00	1264.69
01/02/2008 - 29/02/2008	29	2114424.00	53026.86	2061397.14	2061.40	1.00	2061.40
01/03/2008 - 31/03/2008	31	1542852.00	39221.28	1503630.72	1503.63	1.00	1503.63
01/04/2008 - 30/04/2008	30	2599812.00	68602.26	2531209.74	2531.21	1.00	2531.21
01/05/2008 - 31/05/2008	31	3024648.00	74116.26	2950531.74	2950.53	1.00	2950.53
01/06/2008 - 30/06/2008	30	2775996.00	69794.70	2706201.30	2706.20	1.00	2706.20
01/07/2008 - 31/072008	31	2614752.00	73186.92	2541565.08	2541.57	1.00	2541.57
01/08/2008 - 31/08/2008	31	2557944.00	70947.29	2486996.71	2487.00	1.00	2487.00
01/09/2008 - 30/09/2008	30	1879920.00	55039.02	1824880.98	1824.88	1.00	1824.88
	366	**26452296.00**	**726406.07**	**25725889.93**	**25725.89**	**1.00**	**25725.89**

[1]Enermax 6.6kV data [2]Enermax 380V data [3]Enermax data 6.6kV-380V [5]Eskom Annual Report 2008

APPENDIX B Calculation of Emission Reductions per PDD

Calculating CO_2 emitted as inherent in biogas

Mass of CO_2 emitted inherent in biogas in tonnes for monitoring period	=	(Biogas flowrate) * (the % CO_2 in biogas) * (density of CO_2) * days per year * hours per day / 1000
	=	1900 m3/hr * 39% * 1.82947731 kg/m3 * 366 * 24 / 1000
	=	11 907.97 tonnes CO_2 for the period 1 Oct 2007 – 30 Sept 2008

Calculating CO_2 emitted by methane combustion

Mass of CO_2 due to CH_4 combustion in tonnes per annum	=	(Biogas flowrate) * (the % CH_4 in biogas) * (density of CH_4) * conversion factor * days per year * hours per day / 1000
	=	1900 m3/hr * 57% * 0.666776098 kg/m3 * 2.74342351 * 366 * 24 / 1000
	=	17 401.78 tonnes CO_2 for the period 1 Oct 2007 – 30 Sept 2008

Calculating total CO_2 emitted

Total CO_2 emitted in tonnes per annum	=	mass of CO_2 emitted inherent in biogas + mass of CO_2 due to CH_4 combustion
	=	11 907.97 tonnes CO_2 + 17 401.78 tonnes CO_2
	=	29 309.75 tonnes CO_2 for the period 1 Oct 2007 – 30 Sept 2008

Calculating Project Activity Emissions

(In accordance with par 12 of AMS 1-D(version 9) no leakage is considered as no equipment is transferred from another site)

Project Activity emissions	=	CO_2 emissions from baseline + CO_2 emissions from leakage
	=	29 309.75 tonnes CO_2 + 0 tonnes CO_2
	=	29 309.75 tonnes CO_2 for the period 1 Oct 2007 – 30 Sept 2008

Calculating Baseline Emissions

Emissions baseline in tonnes CO_2/MWh	=	Grid emissions factor * (annual generation MethCap SPV1) + emissions due to flaring
	=	1.00 kg/kWh * 25 725.89MWh/y + 29 309.75 tonnes CO_2
	=	55 035.64 tonnes per annum

Emission reductions for Project Activity

Emissions reductions in tonnes of CO_2 for monitoring period for Project Activity	=	Grid emissions factor * electricity generated in MWh for monitoring period + emissions due to flaring – emissions due to Project Activity
	=	(1.00 kg/kWh * 25 725.89MWh) + 29 309.75 tonnes CO_2 – 29 309.75 tonnes CO_2
	=	25 725.89 tonnes CO_2 for the period 1 Oct 2007 – 30 Sept 2008

APPENDIX C Monitoring Equipment

1. Alstom meters versus Enermax meters

MethCap proposed to install Alstom meters to measure electricity output and consumption, however due to PetroSA requirements Enermax meters were installed to measure both electricity output and consumption. Such Enermax meters meet all the criteria of the Alstom meters as stated in the Monitoring Plan as follows:

Alstom meter	**Enermax meter**	**Documentary support***
Alstom's quality management systems complies with ISO 9001	Enermax meters are supplied by STRIKE Technologies (Pty) Ltd. STRIKE is a wholly owned subsidiary of the ALTRON and POWERTECH Groups, together one of the largest Power Electronics and Telecommunications groups in Southern Africa. STRIKE is an ISO9001: 2000 listed company. It has been ISO9001 certified since 1998 and successfully migrated to the newly introduced ISO9001: 2000 in June of 2003.	Certificate EN ISO 9001:2000
Alstom meter complies with IEC standards	Enermax complies with IEC standards as follows: IEC 62053-21:2003 IEC 62053-22: 2003 IEC 62053-23:2003	Calibration certificates Enermax brochure
The metering system will be calibrated by an accredited laboratory and recalibrated at intervals required by the accredited laboratory, accredited to ISO 17025	The test equipment conforms to IEC 60736 standard and is tested/ calibrated in a ISO 17025 accredited laboratory. Using such test equipment calibration /verification of Enermax meters is done in a controlled laboratory and calibration certificates are issued accordingly. No recalibration is necessary if the meters remain undisturbed.	Calibration certificates.

Alstom meter	Enermax meter	Documentary support*
Alstom complies with VDEW demands [Verband der Elektrizitatswirtschaft/ German Electricity Association]	n/a	Only applicable to Alstom
The meter is designed and manufactured in such a way that it does not need any maintenance interventions in the entire lifetime. Measuring stability assures that no recalibration is required. However, the meter will be re-calibrated at 10 year intervals which is the industry standard.	The meter is designed and manufactured in such a way that it does not need any maintenance interventions in the entire lifetime. Measuring stability of such digital meters assures that no recalibration is required. However, the meter will be re-calibrated should the differential between the Enermax output meter and DIA.NE.WIN data exceed 2%. The meter(s) will be returned to STRIKE Technologies should recalibration be required. Such recalibration will be carried out under laboratory conditions.	Letter from STRIKE Technologies.
The meter with the internal battery assures sufficient capacity for performing battery supported functions for the entire lifetime. The meter is designed for a 20-year lifetime at normal operating conditions.	The meter with the internal battery assures sufficient capacity for performing battery supported functions for the entire lifetime. The meter is designed for a 10-15-year lifetime at normal operating conditions.	Letter from STRIKE Technologies.
The meter continuously records active energy and stores data accumulatively. The data is transmitted electronically and readings are taken online.	The meter continuously records active energy and stores data accumulatively. The data is transmitted electronically and readings are taken online.	Same for both meters

***** Supporting documents held on file and electronically for verification and audit purposes.

2. DIA.NE WIN monitoring system

The DIA.NE WIN system is built around the central on-site computer (server) which is integrated into the switch cabinet of the installation and which stores historical data and generates alarms. The Plant Operator (employed by WSP Energy Management) takes all readings from such central on-site computer.

*Refer DIA.NE WIN and DIA.NE XT information brochure for detailed information.

In theory, the system could offer WSP EMS/MethCap and GE Jenbacher maintenance staff a wide range of functionalities for commissioning, monitoring and maintaining installations and for diagnostic purposes. However a dial-in connection/modem is too slow to transfer the large volumes of DIA.NE data. For the first monitoring period, MethCap has not succeeded in having an ADSL/broadband Telkom line installed at the Power Plant. Telkom was finally able to provide such installation and it was approved by PetroSA in November 2008 and the ADSL line is being installed. WSP EMS/MethCap tried to install a 3G modem connection in the meantime to give GE Jenbacher the required access but the bandwidth was also insufficient given the volume of data. MethCap intends to install the required software in Johannesburg so that the Compliance Officer can access the DIA.NE data for monitoring purposes directly.

3. Training of monitoring personnel

The Plant Operator is employed by WSP EMS and was trained by GE Jenbacher on site upon commissioning. The Plant Operator underwent further training at GE Jenbacher in Austria in June 2008, which allows Extended Customer access to the DIA.NE WIN system

The Enermax meters log data electronically and monthly data is extracted using PMAX software by PetroSA (Tommy Brown). No specialised skills or training is required for such data extraction.

***** Supporting documents held on file and electronically for verification and audit purposes.

APPENDIX D Monitoring Data

1. Measuring and recording

The electricity generated/consumed by the Power Plant is a fraction (c 2%) of the electricity consumed by the entire PetroSA Refinery. PetroSA has a highly effective central control system for all the electricity meters on the PetroSA Refinery Site, including PetroSA meters, Eskom meters and MethCap meters, and such system is managed by Tommy Brown of PetroSA. To prevent duplication of processes and to ensure PetroSA's approval of the metering and billing process, MethCap has delegated the task of monthly measuring and recording of the 380V and 6.6kV Enermax meters to PetroSA (Tommy Brown). The Plant Operator measures and records the DIA.NE data for total electricity output.

2. Verification and quality control of measurement

2.1 Enermax meters

The 380V and 6.6kV Enermax meters continuously records active energy and stores data accumulatively electronically. Such data cannot be manipulated by manual intervention. Real time readings can be taken directly on meters or the PC linked to the meters. However such real time kW reading represents the engine output for an instant only.

The data is transmitted electronically and readings are taken by PetroSA (Tommy Brown) from the Enermax meters (csv files) as well as online via PMAX Software (csv files) on a regular basis during the month and at month end. The Enermax & PMAX csv files are compared for accuracy. The PMAX Software is utilised to generated Excel Spreadsheets and Tariff Reports. These are reported to/emailed to the Plant Operator and to MethCap. Spreadsheets and Tariff Reports are generated for the 380V and 6.6kV meters separately and a consolidated Tariff Report reflects the net active energy generated. The energy charge is calculated in the Tariff Report at a rate determined in accordance with the power purchase agreement between PetroSA and MethCap.

The MethCap Compliance Officer saves all the Enermax/PMAX data to the central server.

The MethCap Compliance Officer verifies the accuracy of the online readings versus the DIA.NE WIN data received from Plant Operator.

2.2 DIA.NE WIN System

The GE Jenbacher engines are equipped with a remote monitoring DIA.NE WIN system which theoretically could provide continuous, live data to GE Jenbacher in Austria and to MethCap in Johannesburg. Agaricus Trading are no longer responsible for operation of the Power Plant and will not need access to the DIA.NE WIN system. Without the ADSL/broadband such remote monitoring has not been possible. The Plant Operator underwent further training at GE Jenbacher in Austria in June 2008, which allows Extended Customer access to the DIA.NE WIN system and he is able to extract the required data for verification purposes.

Real time readings can be taken directly on the DIA.NE screen or on the central on-site PC linked to the DIA.NE. The Plant Operator manually records various real time readings weekly for purposes of the Preventive and Corrective Maintenance Agreement, including the kW produced by each engine. However such real time kW reading represents the engine output for an instant only.

The DIA.NE system continuously records data and stores data accumulatively electronically. Data is stored for various time periods depending on the size of the data files. For example Ignition Voltage Data is stored for about 7 months whereas Monthly Data is stored for 7 weeks and Daily Data for a few days. Such data cannot be manipulated by manual intervention. Only the Plant Operator/Assistant Plant Operator can access the data for purposes of viewing and recording only. The DIA.NE system requires a unique User ID to access the data. Such unique User ID's have been issued by GE Jenbacher to the Plant Operator and Assistant Plant Operator. Following installation of the ADSL/broadband line, GE Jenbacher will have direct access to the data and MethCap Compliance Officer will apply for a User ID in order to access the data.

The Plant Operator extracts and saves to disc DIA.NE data from the DIA.NE system for each engine on a monthly basis. DIA.NE WIN automatically creates Access Files for all the data fields. Such data cannot be manipulated by manual intervention. The monthly discs are couriered to the MethCap Compliance Officer (the files are too large (c 56MB) to send via to email). The Compliance officer saves the data to the central server upon receipt of the disc. The MethCap Compliance Officer exports the Access data to Excel spreadsheets to calculate the total kWh produced per engine per month and compare it to the Enermax data.

Both the DIA.NE Data and Enermax Data contains output (kW) produced by each engine in 30 minute intervals per day. The DIA.NE system and Enermax meter are not perfectly synchronised resulting in a very small and consistent differential (<2%) between the two (refer Data Approval Sheets).

The Plant Operator has only been able to extract data from the DIA.NE system following his GE Jenbacher training in June 2008. MethCap has relied on the data extracted from the DIA.NE system in June 2008 for purposes of verification. The DIA.NE/Enermax differential is very consistent and MethCap is certain that the Enermax readings for October 2007, November 2007 and December 2007 are correct, given also that the measuring stability of a digital meter such as the Enermax meter is assured.

The amount of electricity drawn from the PetroSA grid for consumption by the Power Plant is no more than 3% of the electricity generated by the Power Plant and remains fairly consistent. While running, each engine uses 18,47kW of electricity, which equates to about 40,000kWh per month for 3 engines, and the rest is utilised by balance of plant, for lighting, computers etc. Due to the small quantum of electricity consumed MethCap does not have a separate check system for such electricity.

2.3 Data Storage

The MethCap Compliance Officer archives the Enermax data electronically (on disc and to the central server) and in printed form. The Enermax meter itself stores data accumulatively electronically.

Due to the volume of data from the DIA.NE WIN system is stored electronically only (on disc and to the central server). The DIA.NE system itself stores data for various time periods depending on the size of the data files.

All supporting data is stored electronically (on disc and to the central server) and in printed form.

All data will be available until 2 years after the Project Activity has ended for audit purposes and comparison and analysis by the verifier.

APPENDIX E Internal audit procedures and procedures for corrective action

1. Monthly readings of the Enermax meters and monthly DIA.NE WIN readings by the Plant Operator are captured and compared by the Compliance Officer: MethCap prior to billing.
   - Enermax data is extracted via PMAX software and exported to an Excel spreadsheet. DIA.NE data is extracted via Microsoft Access and exported to an Excel spreadsheet.

2. Previous month end reading will be compared with new month opening reading to ensure correct transfer of closing balances to opening balances.
   - Data on the Enermax meters and the DIA.NE WIN system is stored accumulatively electronically. Manual readings of the digital Enermax meters and the DIA.NE WIN system are not practical because only instantaneous data can be read on the respective meters.

3. An a priori test will be conducted monthly prior to billing i.e. compare metered billing to engine capacity and availability data.
   - Plant operator assesses and reports Power Plant output/ performance for purposes of the PCMA. Power plant output is totally dependent on quality and quantity of biogas received from the digesters and therefore on the PetroSA refinery processes.

4. MethCap will enter into a Preventive and Corrective Maintenance Agreement with GE Jenbacher who in terms of the Agreement contractually guarantee availability of 8030 hours per annum (92%) with penalties for non-achievement. The Agreement covers maintenance of the GE Jenbacher engines as well as the DIA.NE WIN system.
   - Done

5. CDM Africa Climate Solutions (Pty) Ltd (Johan van den Berg) will conduct an audit at least once annually or as required following disputes or preventive and corrective actions. The scheduled annual audit will commence one month prior to the issuance of the emissions report and will include a verification of the calculation of the emissions reductions during the crediting period.
   - There have been no disputes or preventive and corrective actions.

APPENDIX F Plant management and operation

1. Facility management and operation

The day-to-day operation of the engines was intended to be contractually outsourced to the South African agents for GE Jenbacher, Agaricus Trading CC. However such Operations Agreement was assigned to WSP Energy Management Services (a subsidiary of WSP Group Plc) with effect from commissioning. WSP have appointed a Pant Operator and Assistant Plant Operator to operate and maintain the Power Plant.

The periodic maintenance of the engines will be undertaken by GE Jenbacher directly and/or by their agents Agaricus Trading CC under the Preventive and Corrective Maintenance Agreement.

2. Project management

The Power Plant is complete and was commissioned in September 2007. No further requirement for Project Manager other unless planned expansion occurs.

3. PetroSA Safety Health & Environmental Policy

Being a liquid-to-gas refinery site PetroSA has very stringent Health, Safety and Environmental Policies.

During construction of the Power Plant, MethCap, WSP and their appointed contractors and sub-contractors were classified as PetroSA contractors. In terms of PetroSA's Safety, Health and Environment Policy, all such contractors underwent a compulsory on-site induction course and a medical examination prior to being allowed to enter the site to undertake their activities. These contractors were identified by their different colour overalls, as opposed to the navy blue overalls of the PetroSA staff. WSP ensured that all contractors complied with PetroSA's Health and Safety Regulations.

For the duration of the Power Plant's operational life MethCap and WSP will continue to comply with PetroSA's Health, Safety and Environmental Policies.

The Plant remains in compliance with national environmental legislation and regulations. Environmental Management Plan audit and review is due to be undertaken in Q4 2008. Results will be submitted to the relevant authorities, namely DEAT, NERSA, ESKOM.