MONITORING REPORT

1 January – 31 December 2008

JI PROJECT

CO-GENERATION GAS POWER STATION BIOVET

ERU04/33

2006-2012

Revision 5

Peshtera, June 2009

Bulgaria

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Annexes:

Abbreviations used

ABEC	annual baseline electricity consumption in Biovet	MWhe/y
ABHEC	annual heat consumption in Biovet and OLD River	MWht/y
ABNG	annual baseline natural gas energy consumption	TJ/y
AECgr	annual consumption of electricity in Biovet from grid	MWhe/y
AECng	annual natural gas energy consumption by CHP	$1000Nm^3/y$
AECHP	annual electricity produced by CHP	MWhe/y
AECHPgr	annual electricity produced by CHP and sold to grid	MWhe/y
BBEC	annual back up boilers natural gas consumption	TJ/y
BEFel	baseline CO_2 emissions factor for electricity from grid	$kgCO_2/MWh$
BBH	back up boilers annual energy content	MWht/y
BEl	annual baseline CO_2 emissions from electricity supplied by grid	tCO_2/y
BEth	baseline CO_2 emissions that would be offset by heat output	tCO_2/y
BEtotal	total baseline emissions (CO_2 equivalent)	t CO_2 eq/y
CAHO	CHP annual heat output	MWht/y
CEO	annual CHP electricity output	MWh/y
CGS	Co-Generation Gas Power Station	
CHOR	CHP heat output rate	GJ/y
CHP	combined heat power (co-generation)	
CPO	CHP net power output capacity	MW_e
EFel gen	emission factor for electricity generation in Bulgaria	$tCO_2/MWhe$
EF*ng*	CO_2 emissions factor for natural gas combustion/Bulgarian Inventory 2002/	t CO_2/TJ
ER	emission reduction from project activities	t CO_2 eq/y
EU	European Union	
e_{bec}	industrial back up boilers energy content coefficient (LHV basis)	%
GE	General Electric	
GHG	green house gases	
HPP	hydro power plant	
HRSG	Heat Recovery Steam Generator	
PE_{CHP}	annual project emissions from NG combustion in CHP	t CO_2 eq/y
(-) PE*rgrid*	annual project emissions avoided from replaced electricity to grid	t CO_2 eq/y
PE*grid*	annual project emissions from electricity coming by grid	t CO_2 eq/y
PE*total*	total project GHG emissions	t CO_2 eq/y
Q_{LHV}	low heat value of natural gas	$GJ/1000Nm^3$
RES	renewable energy sources	
BCEF	baseline carbon emission factor	

1. Introduction

The Monitoring report is prepared in accordance with the JI - Project Design Document and provides the measurements and calculations of the GHG emissions reduction in result of co –generation installation operation during 2008.

1.1 Project participants

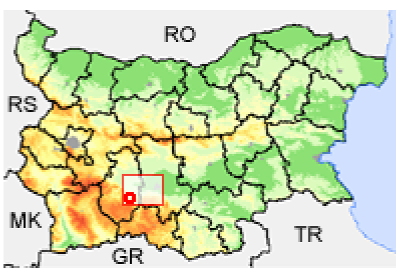
Company name:	**Biovet JSC**
Position in the project:	Owner of the project and Supplier of AAUs and ERUs
Visiting address:	39, Petar Rakov Str
Zip code + city:	4550, Peshtera
Country:	Bulgaria
Contact person:	Michev, Ivan
Job title:	Technical Director
Telephone number:	+ 359 350 65635444, or + 359 889 302945
Fax number:	+ 359 350 65636
E-mail:	i_michev@biovet.com
	http:// www.biovet.com
Company's core business:	Pharmaceutical industry, Food additives for animal's health

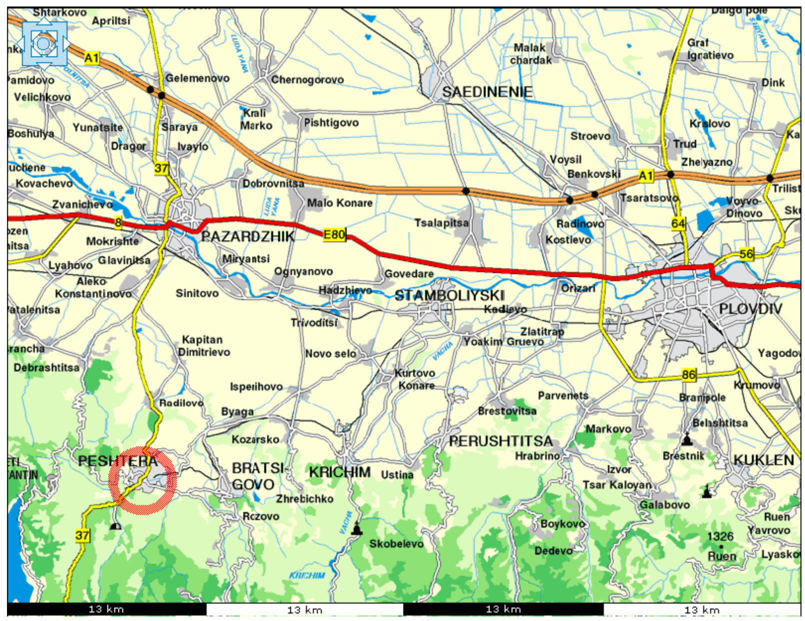
Company name:	**GE Packaged Power, Inc**.
Position in the project:	The main equipment supplier
Visiting address:	2707 North Loop West, Houston
Zip code + city	77008, Houston, Texas
Country	U.S.A.
Contact person:	Mrs. Tatyana Kossekova-Dimitrova
Job title:	Sales & Marketing, Central & Eastern Europe
Telephone number:	+359-2-944-0469
Fax number	+90-212-216-1652
E-mail:	Tatyana.Kossekova@ps.ge.com
	www.gepower.com
Company's core business:	Gas turbines manufacturer

Company name:	**CoGen Engineering LTD**
Position in the project:	PDD developer and consulting.
Visiting address:	14, Stoian Zaimov Str.
Zip code + city:	1421 Sofia
Country:	Bulgaria
Contact person:	Manev, Stefan
Job title:	Executive Director
Telephone number:	+359 2 9632223 or + 359 888 242728
Fax number:	+359 2 8660402
E-mail:	cogen@cogeneng-bg.com
	www.cogeneng-bg.com
Company's core business:	Co-generations and JI projects consulting

1.2 Project location

The project is executed in the town of Peshtera around the facilities of the pharmaceutical company Biovet Joint Stock Company.
The town location can be seen on the map below.
Peshtera is a historical town, established during the second half of the 4^{th} century AD. Its population amount to approximately 21 000 inhabitants, of which 56.3% is in the active employment age. It is situated at 450m altitude, at the foot of the West Phodope Mountains. Peshtera is located 20 km from the town of Pazardjik, 40 km from Plovdiv City and 125 km from Sofia City.





1.3 Background

Biovet is a leading European manufacturer and marketer of medicated and nutritional feed additives, enzymes, bulk active substances and pharmaceuticals for farm animal productivity and animal health. The company offers intermediates, active ingredients and medicines for the human pharmaceuticals industry. Biovet provides enzymes, enzyme complexes, and other ingredients for the baking, brewing, juice production, alcohol production, wine making, oil extraction, pharmaceuticals, paper, detergents, leather and textiles industries.
Biovet was established in 1961, more than 40 years ago. The first manufacturing plant was designed for the production of just one major animal health antibiotic. Throughout the decades, Biovet has been manufacturing a range of veterinary and human products in response to the changing market demands. Today, the product portfolio includes over 80 products for animal health, human health and enzymes.
Since its founding, the company has grown significantly. The Company increased its workforce and expanded its production facilities several times, established a Research

and Development department and built a wastewater treatment plant. Over the recent years, Biovet has made significant investments in plant upgrades, equipment automation, and construction of new production facilities, laboratories and warehouses. At present, the administrative and production complex extends over an area of approximately 150 000 m^2.

Biovet is the main supplier of reduced emissions and is the main organizer and executor of the project. Biovet provided the financing of the project by means of a credit obtained from Bulbank, Bulgaria.

The motives for the realization of this CHP project are based on the analysis of the situation in the country and the reforms in the energy sector with reference to the accession of our country into the EU.

Biovet is very sensitive to the fluctuations of the electricity prices due to the high relative share of its energy costs in the final product price. The unavoidable reforms in the energy sector are related to a future growth of the electric energy prices and their equalization with the average prices for the EU.

Biovet is supplied with electricity from two independent sources and, notwithstanding the above, incidents have occurred, in which the company has been left without electric power supply for over an hour. This has caused serious production losses due to the eradication of the fermentation bacteria and the discontinuation of the fermentation processes. The improvement of the electric power supply reliability is an important factor for the normal operation of Biovet.

It is a fact, that the decommissioned 3rd and 4th blocks of the Kozloduy NPS are expected to be substituted mainly by the new or overhauled facilities of the coal-fueled stations of Maritsa Iztok 1 TPS, Maritsa Iztok 2 TPS . Since the coal powered stations are one of the main sources of the greenhouse gases, this will not lead to a reduction of the greenhouse gases emissions (GHG) in the country and, respectively, of the obligations of Bulgaria with reference to the Kyoto Protocol.

With reference to the above, the Government of Bulgaria accepted new Energy Act (published in State Gazette No. 107 dated December 2003). The new Law is built upon the 2002 Energy Strategy of Bulgaria in accordance with the requirements of the European Union Directives on electricity and natural gas [i]. It is structured in a manner consistent with the modern energy laws- clearly identifies the law general purpose. Its general purpose is to create conditions for the establishment of a competitive energy market, lower the costs of energy supplied to the public, to promote the sustainable development of renewable energy sources (RES) and the co-generations for efficiency combined cycle generation of electricity and heat. The Chapter 11 / Articles 157-163/ of the Energy Act especially promotes the electricity produced from RES and high efficiency CHP.

The main promotion is that the public suppliers and distributors of energy are obligated to buy all produced from RES and CHP quantity of energy on preferential and regulated prices to come in force of the green certificates. The law was reformed in September 2006.

Significant document with reference to the reduction of the hazardous air emissions is also the approved in February 2004 Energy Efficiency Act.

The issue with reference to the construction of an own co-generation plant within the facilities of Biovet AD has been under discussion for a number of years. Various alternatives were studied for its construction on. In the end of 2003, the final decision was made for building the Plant on the basis of gas-turbine engines with electric and steam cycles, as technically the most efficient alternative.

The construction of this highly efficient plant for the production of electrical and thermal power should resolve the following issues of Biovet AD:

- High reliability of the electric power supply of the facilities will be guaranteed. In this case, the fact that even a ten-minute power supply disruption leads to high production losses, was taken into consideration;
- As a result of the comparatively low and stable in the time prices of the electricity and steam produced from the CHP, shall ensure the prognostic development of the factory and an improving the compatibility of the company on the international markets.

1.4 Description of the Project activities

A common view of the realized co-generation project is shown on the picture bellow:

The main equipment of the Co-generation Gas Power Staion is:
At the heart of Biovet's cogeneration plant is GE AERO ENERGY's LM2000 aeroderivative gas turbine genset. The LM2000 gas turbine, which is actually a re-rated LM2500 gas turbine, has a rating of 18MW at 36.4% thermal efficiency.
The main technical parameters of the gas turbine genset are shown in the table No.1 below:

Parameters	Dime	Co-gen Set
Gas Turbine Type		LM 2000
Year of production		2005
Producer		GE Packaged Power, Inc., USA
Electrical power	[MWe]	18
Fuel – Natural gas LHV	[kJ/kg]	49548
Fuel consumption	[kg/h]	4000
Exhaust gases temperature	ºC	460
Exhaust gases flow	[kg/s]	61.2
NOx control –Steam	[kg/h]	4508 (340ºC, 40 barg)
Generator Type		Synchronous
Year of production		2005
Producer		MEIDENSHA, USA
Rated Voltage	[kV]	6.3
Rated Power	[KVA]	21250
Rated current	[A]	2045
Efficiency	[%]	97.9

Table No.1 Genset main technical data

This gas turbine is a single shaft gas turbine with a free power turbine.
The axial compressor is made up of sixteen (16) stages, at a pressure ratio of 16.4:1. A two stage axial turbine drives the sixteen stage axial compressor. Both the compressor and turbine are on one shaft.
The free power turbine is a two-stage design, which is directly coupled to the generator, and is generating electricity at 3,000 RPM (or 50Hz).
The combustion system, chosen for this project, is GE AERO ENERGY's ***S***ingle ***A***nnular ***C***ombustor (**SAC**). This combustor design shares a lot of similarity / commonality with the aircraft engine combustor, except that this combustor is also designed to burn natural gas, as well as liquid fuel (eg: Diesel, Kerosene, etc…).
NOx requirement for Biovet's project is 25vppm at 15% O_2 (or 51mg/Nm^3 at 15% O_2).
To meet the NOx requirement, the SAC combustor requires ***S***team ***I***njection (**SI**), to reduce the unabated emissions to the required level. For Biovet's project, SI is used.
The SI flow is directly injected into the combustor, and will reduce the unabated NOx emissions to the required 25vppm at 15% O_2.
The steam for NOx control shall be provided by the ***H***eat ***R***ecovery ***S***team ***G***enerator (**HRSG**). The HRSG is designed to provide the required amount of steam, at the required pressure and temperature, and quality levels, as stated by GE AERO ENERGY.
The main technical parameters of the boiler are shown in the table No.2 below:

Parameters	**Dimer**	**Heat Recovery Steam Generato**
Type		HRSG/one pass boiler/
Year of production		2005
Producer		Marcegaglia, Italy
Rated steam production		
Steam high pressure (steam injection)	[t /h]	5
- Temperature	[ºC]	340
- Pressure	[barg]	40
Steam low pressure (technological steam)	[t /h]	25.5
- Temperature	[ºC]	179
- Pressure	[barg]	9
Inlet water temperature		20
Blowings	[%]	0.7
Inlet exhaust gases pressure	[mmH_2O]	210
Outlet exhaust gases temperature	[ºC]	193

Table No. 2 – Heat Recovery Steam generator main technical data

The genset module is disposed in separate building for additional noise attenuation. The electrical and control equipment are in separate building around. The switch gears 6 kV and 0.4 kV, the accumulator batteries, transformers own needs etc. are on the first floor, the control room is on the second floor. The high level automation system is a DeltaV, Emerson system.

The water treatment plant for the boiler water is with capacity to 90 m^3/h. The technology is based of mechanical treatment on the first stage, a reverse osmosis on the second stage and electrodialysis with ion exchange for deep demineralization of the water on the third stage.

Performance figures like this for one “typical” month are used in the design of the cycle and the heat balance analyses for each month of the year. The basic data for each month are shown below.

1.5 Implementation of the project

The project implementation is shown in the table No.3 below:

No.	Name of activity	Terms of execution
1	Start of the project	April 2004
2	Project detail design	July 2004- December 2004
3	Construction on site	February 2005- September 2005
4	Equipment delivery	June 2004 – June 2005
5	Equipment installing	May 2005 –September 2005
6	Operation tests	September 2005-October 2005
7	Commissioning	October 2005 – November 2005
8	Start of operation	26.11.2005

Table No.3 – Implementation of the project

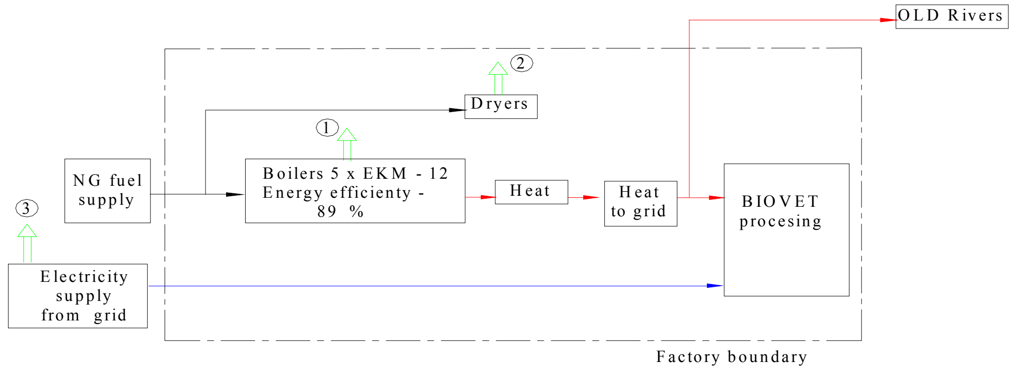
1.6 Expected capacity

The production capacity of the co-generation station has been selected mainly on the bases of the steam needs of the factory. The expected annual availability was estimated of 8200 hours per year.

2. Methodology

The methodology used for the baseline and monitoring setting in the PDD is on the base of "Operational Guidelines for Project Design Documents of Joint Implementation Projects" of the Ministry of Economic Affairs of the Netherlands 2004 – "Operational Guidelines for PDD's of JI projects-Specific project categories-CHP".

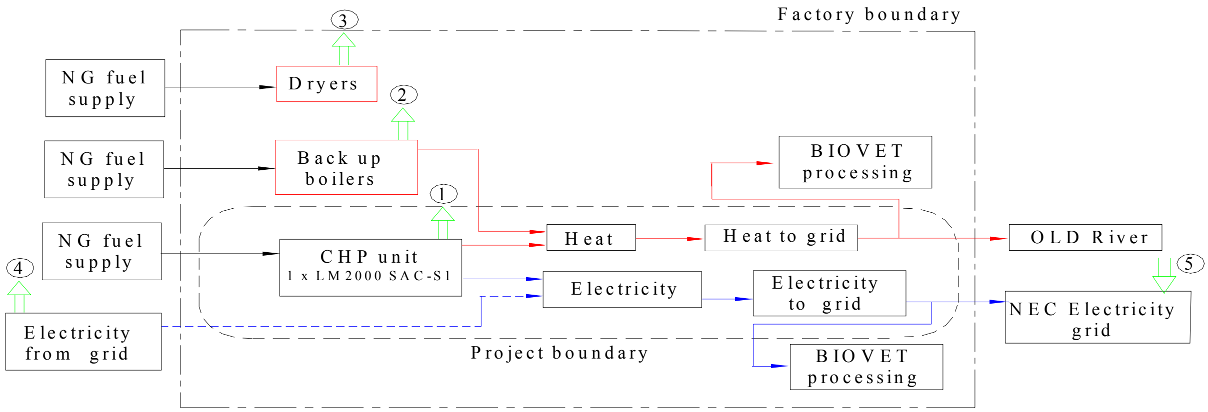
2.1 Flowchart of the situation before the implementation of the project – separate generation of heat and electricity.



1 – CO_2 emissions (combustion in boilers)
2 – CO_2 emissions (combustion in dryers)
3 – CO_2 emissions (electricity from grid)

Fig.1- Flowchart of current delivery system with it's the main components and their connections.

2.2 Flowchart of the situation after the implementation of the project



1 – Direct on-site CO_2 emissions (comb in CHP)
2 – Direct off-site CO_2 emissions (comb in back up boilers)
3 – Off-site CO_2 emissions (comb in dryers)
4 – Direct off-site CO_2 emissions (electricity from grid)
5 – Direct off-site CO_2 avoided emissions (electricity to grid)

Fig 2 - Flowchart of the situation after the implementation of the project

2.3 Direct and indirect emissions

On-site emissions			
Project	**Current situation**	**Direct or indirect**	**Include or exclude**
CO_2 emissions from NG combustion in CHP	CO_2 emissions from NG combustion in boilers	Direct	Include
	CO_2 emissions from NG combustion in dryers	Direct	Exclude, do not influe by the project
Off-site emissions			
Project	**Current situation**	**Direct or indirect**	**Include or exclude**
CO_2 emissions from NG combustion in back - up boilers		Direct	Include
CO_2 emissions from NG combustion in dryers		No influence	Exclude, do not influe by the project
CO_2 emissions from electricity grid	CO_2 emissions from electricity grid	Direct	Include
CO_2 avoided emissions to electricity grid		Direct	Include

Table No. 4 - Direct and indirect emissions

2.4 Estimation of the baseline emissions

Annual NG consumption in boilers – ABNG in order to cover the heat demand ABHEC is given by:

$$ABNG = (100 * ABHEC / e_{bec}) * 3.6/1000\ ,\ TJ/y$$

where: e_{bec} – boiler energy content coefficient, determined from engineer's analyses.
ABHEC - is total annual heat consumption in Biovet and OLD River equal of the produced heat from CHP and back up boilers, measured by the steam flow meters in [MWht] and filled monthly in the tables of the Monitoring model.

e_{bec} = BBH/BBEC*3.6/1000*100, %
BBH - back up boilers annual energy content MWht/y;
BBEC - annual back up boilers natural gas consumption TJ/y,

$$ABHEC = BBH + CAHO,\ MWht/y$$

here, BBH – back up boilers annual heat production, MWht/y;
CAHO - annual heat energy output from CHP measured from the steam flow meter in [MWht] and filled monthly in the tables of the Monitoring model.

The estimations of annual baseline CO_2 emissions – BE_{th} from boilers are given by:

$$BE_{th} = ABNG * EFng,\ t\ CO_2/y$$

where: EFng– emission factor for NG combustion in boilers - t CO_2/TJ /look in point 2.7 below/.

$$BEl = ABEC * BEF_{el}\ ,\ t\ CO_2/y$$

where: ABEC, MWhe/y– annual baseline electricity consumption in Biovet .

$$ABEC = AECgr + (AECHP – AECHPgr)$$

here, AECgr, MWhe/y – electricity consumed in Biovet by grid.
AECHP, MWh/y – annual electricity produced from CHP, measured at the outlet of CHP (side 6.3 kV).
AECHPgr, MWh/y – annual electricity produced from CHP and sold to the electrical distribution company, measured at the main power transformers (side 110 kV).
BEFel [tCO_2/MWh] – annual baseline emission factor for electricity from grid /look in point 2.7 below/

Total baseline emissions are:

$$BE_{total} = BE_{th} + BEl\ ,\ t\ CO_2/y$$

Remark:

The formulas presented above, in principle are the same as in PDD format, but they are considered to the detail monitoring process realization.

2.5 Estimation of the project emissions

Direct on-site CO_2 emission from NG combustion in CHP - PE_{CHP}

$$PE_{CHP} = AEC\ ng * Q_{LHV} * EFng /1000,\ t\ CO_2/y$$

Where : AEC ng, $1000Nm^3/y$ - annual NG consumption from CHP, measured by gas flow meter. The measurements monthly are filled in the tables of the Monitoring model.

Q_{LHV} – low heat value of NG –GJ/1000 Nm³/y. LHVs of NG are extracted by gas quality certificates presented from Bulgargas monthly. Look in Annex No.1 to the Monitoring Report.

EFng – emission factor for NG combustion in boilers - t CO_2/TJ /look in point 2.7 below/.

Direct off-site CO_2 emission from NG combustion in back up boilers - PE_{bb}

$$PE_{bb} = BBEC * EFng,\ ,\ t\ CO_2/y$$

Where: BBEC, *TJ/y* - annual back up boilers NG energy consumption is calculated:

$$BBEC = (100 * BBH / e_{bec}) * 3.6 /1000,\ TJ/y;$$

here, BBH – back up boilers annual heat production, MWht/y;

e_{bec} – back up boiler energy content coefficient, determined from engineer's analyses

EFng– emission factor for NG combustion in boilers - t CO_2/TJ /look in point 2.7 below.

Direct off-site CO_2 emission from additional electricity from grid - PE_{grid}

CO_2 emissions caused by additional electricity from grid, in order to cover the electricity consumption of Biovet.

$$PE_{grid} = AECgr * BEF_{el}\ ,\ t\ CO_2/y$$

Where: AECgr, MWhe/y - electricity coming form grid to cover the needs of Biovet.

BEF_{el} – emission factor for electricity from grid, /look in point 2.7 below/.

Direct off-site avoided CO_2 emission - replaced electricity to grid – PE_{rgrid}

$$(-)\ PE_{rgrid} = AECHPgr * EFel_{.gen}$$

Were: AECHPgr, MWh/y – annual electricity produced from CHP and sold to the electrical distribution company,;

$EFel_{.gen}$, tCO_2/MWh - is emission factor for generated electricity /look in point 2.7 below/.

Total CO_2 emissions from the project implementation are:

$$PE_{total} = PE_{CHP} + PE_{bb} + PE_{grid} + (-)\ PE_{rgrid},\ t\ CO_2/y$$

2.6 Estimation of CO_2 emission reductions

The difference between total baseline emissions and total project emissions represent the emission reduction from the project activity**:**

$$ER = BE_{total} - PE_{total},\ t\ CO_{2-eq}/y$$

Remark: The leakages of emissions from the producing and transportation of the Natural gas are neglected because of its insignificant.

2.7 Baseline and project emission factors estimation

The emissions reductions in the Monitoring Report are calculated with the using the Netherlands emission factors:

2.7.1 Baseline and project emission factors for electricity

$EFel_{.gen}$ emission factor is used for calculation of the emission reduction from CHP generated and sold to the grid (NEC) electricity and ***BEFel*** emission factor for electricity consummated from grid in Biovet.

The calculations of the emissions reduction for 2008 shown in point 4 below is prepared with emission factors in accordance with the "Operational Guidelines for Project Design Documents of Joint Implementation Projects" of the Ministry of Economic Affairs of the Netherlands 2004 – Annex B, chapter B.4 table B1 and table B2. The values for the emissions factors are given in the table below:

	Year	2005	2006	2007	2008	2009	2010	2011	2012
$EFel_{.gen}$	[tCO_2/MWh]	0.814	0.797	0.779	0.761	0.743	0.725	0.707	0.689
BEFel	[tCO_2/MWh]	0.957	0.934	0.912	0.890	0.867	0.845	0.822	0.800

Table No.5 – Netherlands baseline emission factors for electricity

The procedure for calculation of Bulgarian ***$EFel_{.gen}$***, for the verification process needs, is still not officialy develope from MOEW for all JI projects.
The emission factor for the electricity from grid ***BEFel*** is calculated on the base ***$EFel_{.gen}$*** increased with the average percent of looses in the grid */Source-NSI Bulgaria Statistical Journals - National Material Balance - Electro energy table – (transportation and distribution looses)* 100 / (consumption-total)/*. The values for 2005 is 10.8 % , 10.4% for 2006 and 10.12% for 2007. The tables for 2007 are attached in Annex No. 2 to the Monitoring report.
Obviously, Bulgarian looses in the grid are less, around 10.4%, than implemented in the Netherlands emission factor calculation 16.4% looses.

The calculations really can(will) use the data for the Bulgarian Energy Industrie work from "one year before". The reason for this is the necessary time for statistical data collection (normally to the end of March for the last year).
The same situation is with the calculation of the evarage percent of the electrical grid looses for calculation of ***BEFel***.

2.7.2 Baseline and project emission factor for Natural gas

The calculations of the emissions reduction for 2008 shown in point 4 below are prepared with emission factor for NG combustion in CHP and Back up Boilers in accordance with the "Operational Guidelines for Project Design Documents of Joint Implementation Projects" of the Ministry of Economic Affairs of the Netherlands 2004 – Annex C, chapter C.1. The used value is *EFng* = 56,1 t CO_2/TJ .

3. Monitoring

This project comprises the installation of a natural gas-fired cogeneration system at an industrial plant, where electricity and heat are provided separately, prior to project implementation. The Monitoring is based on recording natural gas used by the cogeneration plant, and electricity and heat supplied by cogeneration plant to the factory, as well as heat production from back up boilers and exchanged electricity with the power grid.

3.1 Data monitored

Considering the project boundary, the following data need to be monitored in order to estimate project and baseline emissions, and emissions reductions:

- Natural gas used by the cogeneration plant, Nm^3.
- Net electricity produced by cogeneration plant, MWhe
- Exchanged electricity with the power grid, MWhe
- Net heat supplied by cogeneration plant to factory, MWht
- Energy content supplied by back up boilers, MWht
- Energy content efficiency of back boilers station providing heat to the factory, %

Data are collected on a monthly basis for the duration of the project lifetime and crediting period (7 years). CO_2 emissions following project implementation are determined from the parameters monitored, as described above.
The monitoring plan describes the procedures for data collection, and auditing required for the project, in order to determine and verify emissions reductions achieved by the project. Biovet JSC is certficated by ISO 9001 and all procedures above and all procedures for quality control (QC) and quality assurance (QA) are described inside.

№	**Data type**	**Data variable**	**Data unit**	**Measured (m), calculated (c) or estimated (e)**	**Recording frecuency**	**Proportion of data to be monitored**	**How will the data archived? (electronic/paper)**	**For How long is archived data to be kept?**
1	Volume of natural gas consumed from CHP;	V_{NG}	Nm^3	m	Mont	100%	Paper (field record) Electronics (spreadsheet)	Paper 1 years Electronics 7 years
2	Co-generation electricity production	E_{CHP}	MWhe	m	Mont	100%	Paper (field record) Electronics (spreadsheet)	Electronics 7 years
3	CHP steam generation to industrial plant	G_{STEAM} Q_{steam}	Tons MWht	m	Mont	100%	Paper (field record) Electronics (spreadsheet)	Paper 1 years Electronics 7 years
4	Efficiency of existed boilers	e_{bec}	-	c	Year	100%	Paper (field record) Electronics (spreadsheet)	Paper 1 years Electronics 7 years
5	Low and High heating values of NG	LHV, HHV	$KKal/Nm^3$	m	Month	100%	Paper (Protocols Bulgargas)	Paper 1 years
6.	Back up boilers steam generated	G_{STEAM} Q_{steam}	Tons MWht	m	Month	100%	Paper (field record) Electronics (spreadsheet	Paper 1 years Electronics 7 years
7.1	Electricity imported from the grid	Econs	MWhe	m	Month	100%	Paper (field record) Electronics (spreadsheet	Paper 1 years Electronics 7 years
7.2	Electricity exported to the grid	Eg	MWhe	m	Month	100%	Paper (field record) Electronics (spreadsheet	Paper 1 years Electronics 7 years

Table No.6 - Data collecting in order to monitor the project and baseline emissions

3.2 Measurement scheme and measurement devices

The measurement scheme realized (measurement devices and the measurement points) for the data collecting in order to monitor the project emission, baseline emissions and estimation of the emissions reduction are given on Fig. No. 3 below in outline.

Shortly descriptions of the used measurement devices in accordance with Table No. 6 and Fig. No. 3 positions are shown in Table No. 7 below.

Position No. (acc. Table No.7 and Fig. No3)	Quantity measured and device installing place	Technical parameters	Dimensions	Technical parameters values	Period of calibration	Calibrationand Conformity certificates	Remark
1	**2**	**3**	**4**	**5**		**6**	**7**
1	**Gas flow meter – Co generation gas consumption**						
1.1	Volume (V_{NG}) of natural gas	Model		TRZ G250	Every two years /Ordinance No.A-412 16.08.2004	Protocol No80067120 /10.12.2007	
		Type		Turbine meter			
		Producer/ Year		Elster /2005			
		Serial Number		800067120			
		Flow range	[m^3/h]	5 ÷ 400			
		Pressure range	[bar]	10 ÷ 100			
		Accuracy (0.2 Q_{max} ÷ Q_{max})	[%]	± 1.0			
1.2	Electronic correction device	Model		Explorer FT	Every two years /Ordinance No.A-412 16.08.2004	Calibr. Cert. NV 01 / 15.02. 2007 NV 04 / 05.02. 2008	
		Producer/ Year		Pietro Fiorentini / 2005			
		Serial Number		05N0905			
		Range - temperature	[°C]	- 20 ÷ + 50			
		Range - pressure	[bar]	7 ÷ 35			
		Accuracy (permissible deviation) - for temperature - for pressure	 [°C] [%]	 ± 0.15 ± 0.10			
2	**Electro meter – Co generation electricity production**						
2.1	Current transformers – three pieces	Model		ARJA1N2	NOTE 1	Test Protocols of Merlin Gerin from 04.04.2005	
		Producer/ Year		Merlin Gerin/2005			
		Serial Number		0518191, 0518192, 0518193,			
		Range- I side/II side	[A]	2500/5			
		Voltage side	[kV]	6.3			
		Accuracy class		0.5			
2.2	Voltage transformers – three pieces	Model		VRQ3NS2	NOTE 1	Test Protocols of Merlin Gerin from 15.04.2005	
		Producer/ Year		Merlin Gerin/2005			
		Serial Number		0519369, 0519370, 0519371,			
		Range- I side/II side	[V]	6300/100			
		Voltage (max)	[kV]	7.2			
		Accuracy class		0.5			

1	2	3	4	5		6	7
2.3	Electrical two way meter	Model		AINRTL 3 phases, 3 tariffs	Every two years /Ordinance No.A-412 16.08.2004	Test Protocol №136 /12.12.2007	
		Energy		Active + Reactive			
		Producer/ Year		ABB			
		Serial Number		02210367			
		Range U_R / I_R	[V/A]	3x58..277/100..480V 3 x 1 (10) A			
		Constant		30000			
		Voltage side	[kV]	6			
		Accuracy class		0.2S			
		Permissible deviation	[%]	0.2			
		Last check					
3	**Steam flow meter – Co generation generated steam (Biovet technological needs)**						
3.1.1	Transmitter for pressure measurement	Model		3051TG3A2B21 BB4S5Q4	Every two years /Ordinance No.A-412 16.08.2004	Cal.Certific. No.NV 02/19.02.2007 No.898 /31.10.2008	
		Producer/year		Rosemount/2005			
		Serial No.		7984427			
		Range	[bar]	-1 ÷ 55.2			
		Lower range value	[bar]	0			
		Calibration value	[bar]	20			
		Output	[mA]	4 ÷ 20 linear			
		Permissible deviation	[%]	0.1 from scale			
3.1.2	Input current loop for pressure measurement	Serial No.		L044604994	Every two years /Ordinance No.A-412 16.08.2004	Calibr. Cert. No.NV 09/16.08.2007 No.NV 13/26.08.2008	
		Producer/year		Rosemount/2005			
		Range	[mA]	4 ÷ 20 linear			
		Permissible deviation	[%]	0.1 from scale			
		Calibration values	[mA]	4, 12, 20			
3.2.1	Transmitter for temperature measurement	Model		644HAI1XAQ4	Every two years /Ordinance No.A-412 16.08.2004	Calibr. Cert. No.NV 04 /21.02.2007 No.897 /31.10.2008	Transmitter S/N 1957813 was changed with S/N 1957228 Protocol №9/23.09.2008
		Sensor type		PT100_385 4 wire			
		Producer/year		Rosemount/2005			
		Serial No.		1957228			
		Range	[°C]	0 ÷ 200			
		Lower range value	[°C]	0			
		Calibration values	[°C]	0, 50, 100			
		Output	[mA]	4 ÷ 20 linear			
		Permissible deviation	[%]	0.2 from scale			
3.2.2	Input current loop for temperature measurement	Serial No.		L044604982	Every two years /Ordinance No.A-412 16.08.2004	Calibr. Cert. No.NV 08 /15.08.2007 No.NV 12 /26.08.2008	
		Producer/year		Rosemount/2005			
		Range	[mA]	4 ÷ 20 linear			
		Permissible deviation	[%]	0.1 from scale			
		Calibration values	[mA]	4, 12, 20			

1	2	3	4	5		6	7
3.3.1	Flow element (Diaphragm)	Element type		Orifice plate Stand.	Every two years /Ordinance No.A-412 16.08.2004	1. Steam flow compens. calc. 2. Conform. declaration – 04/02/2005 3. Inspection report - 78204 – TVD-1 /04.02.2005	
		Pressure type -Upstream	[barg]	9			
		Serial No.		C-782/04 /			
		Element bore	[mm]	186,628			
		Thickness	[mm]	6			
		Flow rate	[kg/h]	45000			
		Difference pressure	[mm H2O]	3924.231			
		Pressure loss	[mm H2O]	2403.280			
		Temperature	[°C]	183			
3.3.2	Differential pressure transmitter for steam flow measurement	Model		3051CD3A02A1 BS5Q4	Every two years /Ordinance No.A-412 16.08.2004	Calibr. Cert. No.NV 03 /20.02.2007 No.899 /31.10.2008	
		Producer/year		Rosemount/2005			
		Serial No.		7984424			
		Range	[mm H2O]	0 ÷ 5000			
		Lower range value	[mm H2O]	0			
		Calibration values	[mm H2O]	0, 2500, 5000			
		Output	[mA]	4 ÷ 20 linear			
		Permissible deviation	[%]	0.2 from scale			
3.3.3	Input current loop for differential pressure measurement	Serial No.		L044604994	Every two years /Ordinance No.A-412 16.08.2004	Calibr. Cert. No.NV 10 /17.08.2007 No.NV 14 /27.08.2008	
		Producer/year		Rosemount/2005			
		Range	[mA]	4 ÷ 20 linear			
		Permissible deviation	[%]	0.1 from scale			
		Calibration values	[mA]	4, 12, 20			
3.4	Flow computer steam measurements integrator - electronic device to the co-generation control system	Module tag		B-Fl-002		1. Module structure	The measurement device is integrated part from the central control system of the co-gene ration plant
		Path		Boiler/ B-Fl-002			
		Execution period	[s]	1			
		History recorders	number	6			
		Value recorded		AI1/OUT.CV LP_ST_TOTAL_MONT.CV LP_STEAM_MASS_FL.CV LP_STEAM_TOTAL.CV STEAM_TOT_RESET.CV STEAM_TOTM_RESET.CV			
		Deviation		0.01			
6	**Steam flow meter – Steam Power Station generated steam (to Biovet and Old River)**						
6.1	Annubar Flowmeter – two positions after Boiler No.1 and after Boiler No.2	Serial No. - Boiler No. 1 - Boiler No. 2		3095MFAS060C CHPS1T100T32 BA1BQ4 OB-FT-001 OB-FT-002	Every two years /Ordinance No.A-412 16.08.2004	1.Annubar Calculation Data Sheet/ 10.032005 2. Primary Element Report /14.03.2005	
		Type: - Primary element - Annubar - Meter tube sizing /diam./	[mm]	485 Annubar 3095MFA 154 at 20°C			
		Producer/year		Rosemount/2005			
		Sensor size		T1 direct mounting			

1	2	3	4	5		6	7
		Range - pressure - temperature - minimum flow - normal flow - maximum flow	[barg] [°C] [Ton(M)/h] [Ton(M)/h] [Ton(M)/h]	15 200 4.0 10.0 12.0			
		Calculated data: -Diff. press. /norm. flow/ -Structural limit flow -Resonant frequency -Flow coefficient -Permanent press. Loss -Velocity at max. flow	 [mbar] [Ton(M)/h] [Hz] [mbar] [m/s]	 70.720 41.120039 629.20 0.5784 8.759 38.201			
6.2	Annubar differential pressure transmitter for steam flow measurement- two positions after Boiler No.1 and after Boiler No.2	Model		3095MV	Every two years /Ordinance No.A-412 16.08.2004	Calibr. Cert. No.NV 11 /03.10.2007 No.NV 17 /14.11.2008 No.NV 12 /03.10.2007 No.NV 12 /18.11.2008	
		Producer/year		Rosemount/2005			
		Serial No. - Boiler No. 1 - Boiler No. 2		 SN8008296WO1 209187 OB-FT-001 SN8008297WO1 209187 OB-FT-002			
		Range: - Diff. pressure sensor - Steam pressure sensor - Temperature sensor	 [mbar] [bar] [°C]	 - 622 ÷ + 622 0.0 ÷ 55 -183 ÷ +821			
		Operating conditions: - Pressure - Temperature	 [kPa] [°C]	 260 ÷ 1300 140 ÷ 196			
		Output	[mA]	4 ÷ 20 linear			
		System mass flow accuracy	[%]	1 of mass flow rate			
		Repeatability	[%]	0.1			
6.3	Flow computer steam measurements integrators for Boiler No.1 and for Boiler No.2	Model		MS8202AI/Kb	Every two years /Ordinance No.A-412 16.08.2004	Calibr. Cert. No.NV 13 /14.11.2007 No.NV 15 /11.11.2008 No.NV 14 /14.11.2007 No.NV 16 /12.11.2008	
		Producer/year		Microsyst /2006			
		Serial No. - Boiler No. 1 - Boiler No. 2		 SN-35528 SN-35603			
		Analog Inputs : - voltage - current	 [V] [mA]	 0 ÷ 5(10) 0(4) ÷ 20			
		Digit Outputs		Relays K1÷K3			
		Analog Outputs re-transmitters - voltage - current	 [V] [mA]	 0 ÷ 5(10) 0(4) ÷ 20			
		Display		0 ÷ 999999			
		Calibration values	[mA]	4, 8, 12, 16, 20			
		Permissible deviation	[LSB]	± 1			

<table>
<tr><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th></th><th>6</th><th>7</th></tr>
<tr><td>7</td><td colspan="7">Electro meters – Electricity exchange with the national electricity grid (to Biovet and Co-gener. to grid)</td></tr>
<tr><td rowspan="7">7.1</td><td rowspan="7">Current transformers – 2 x 3 pieces at transformers 110/6.3 kV – el. leading line- “Dipel” and “Isperihovo”</td><td>Model</td><td></td><td>TMO-126</td><td rowspan="7">NOTE 1</td><td rowspan="7"></td><td rowspan="7">NEC is owner of the transformers</td></tr>
<tr><td>Producer/ Year</td><td></td><td>Bulgarian/1982</td></tr>
<tr><td>Range- I side/II side</td><td>[A]</td><td>200/5</td></tr>
<tr><td>Voltage side</td><td>[kV]</td><td>110</td></tr>
<tr><td>Accuracy class</td><td></td><td>0.5</td></tr>
<tr><td>Rated power</td><td>[VA]</td><td>30</td></tr>
<tr><td>Last check</td><td></td><td>07.2005/11.2005</td></tr>
<tr><td rowspan="6">7.2</td><td rowspan="6">Voltage transformers – 2 x 3 pieces at transformers 110/6.3 kV – el. leading line- “Dipel” and “Isperihovo”</td><td>Model</td><td></td><td>HMO-126</td><td rowspan="6">NOTE 1</td><td rowspan="6"></td><td rowspan="6">NEC is owner of the transformers</td></tr>
<tr><td>Producer/ Year</td><td></td><td>Bulgarian/1981</td></tr>
<tr><td>Range- I side/II side</td><td>[V]</td><td>110000/100</td></tr>
<tr><td>Voltage</td><td>[kV]</td><td>110</td></tr>
<tr><td>Accuracy class</td><td></td><td>0.5</td></tr>
<tr><td>Last check</td><td></td><td>07.2005/11.2005</td></tr>
<tr><td rowspan="11">7.3</td><td rowspan="11">Electrical two way meters- 2 pieces at transformers 110/6.3 kV – el. leading line- “Dipel” –Trans form. No.1 and “Isperihovo”- Transf. No..2</td><td>Model</td><td></td><td>ANTRAL-X
3 phases,
3 tariffs</td><td rowspan="11">Every two years /Ordinance No.A-412 16.08.2004</td><td rowspan="11">Term of calibration validity September 2007 – Letter 134/26.02.2007 of Reg. Dep. of Bulgarian .Metrology Institute Calibration proofs.
Next test 08.2009</td><td rowspan="11">NEC is owner of the electri cal meters</td></tr>
<tr><td>Energy</td><td></td><td>Active +
Reactive</td></tr>
<tr><td>Channels</td><td></td><td>4x3 tariffs
independent
1- in active
2-in reactive
3- out active
4- out reactive</td></tr>
<tr><td>Producer/ Year</td><td></td><td>ABB Power T/1999</td></tr>
<tr><td>Serial Number</td><td></td><td>G002364808-Tr.1
G002365120-Tr.2</td></tr>
<tr><td>Range U_R / I_R</td><td>[V/A]</td><td>3x58..277/100..480V
3 x 1 (10) A</td></tr>
<tr><td>Constant</td><td></td><td>44000</td></tr>
<tr><td>Voltage side</td><td>[kV]</td><td>110</td></tr>
<tr><td>Accuracy class</td><td></td><td>0.2 S</td></tr>
<tr><td>Permissible deviation</td><td>[%]</td><td>0.2</td></tr>
<tr><td>Last check</td><td></td><td>08.2007</td></tr>
</table>

NOTE 1: **§ 15** of the Government Decree No. 126 from 2nd of June 2007 regarding changes and amendments in the Regulation for measurement devices which are subjected to metrological control revokes the requirement for subsequent testing of current and voltage transformers.

Test and Calibration Protocols for the measurement devices are shown in Annex No. 3 to the Monitoring Report.

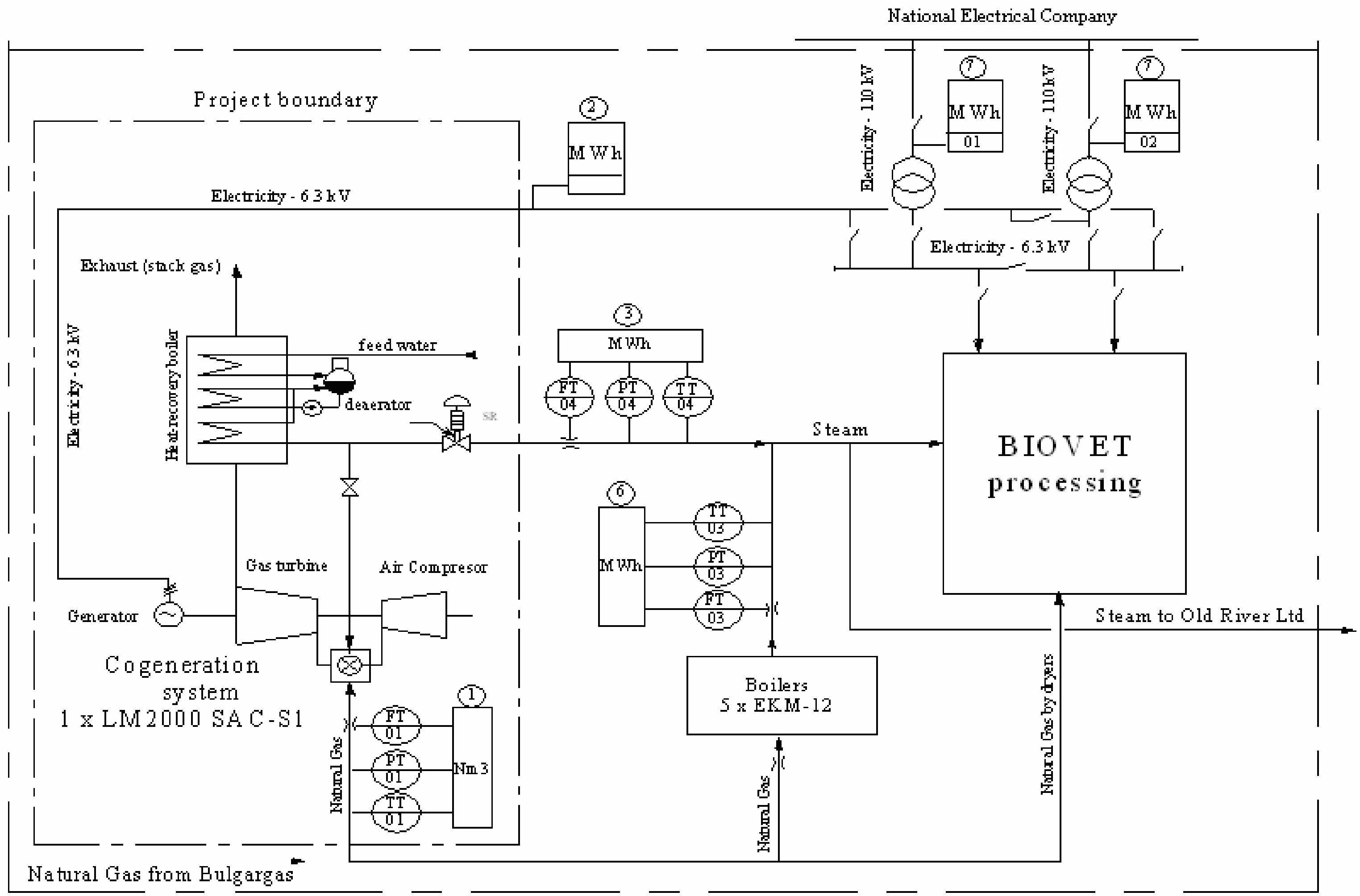


Fig. No. 3 Biovet project measurement scheme

4. Measurement data 2008 collection

The measurement data are collected from the measurement devices outlined above in accordance with the Monitoring plan, monthly for the period from January to the end of December 2008. The data are filled in the tables of the Monitoring model in Excel format and are the base for automatically calculations of the baseline, project line emissions and the emissions reduction.
The data collected are shown in the input tables below:

2008

Net Energy content from CHP - to Biovet

Month	Specific Enthalpy	Energy content		
	KJ/kg	t	MJ	MWht
Jan	2777,8	22 545	62 625 501	17 396
Feb	2777,8	19 364	53 789 319	14 941
Mar	2777,8	19 708	54 744 882	15 207
Apr	2777,8	15 897	44 158 687	12 266
May	2777,8	20 072	55 756 002	15 488
Jun	2777,8	15 818	43 939 240	12 205
Jul	2777,8	21 469	59 636 588	16 566
Aug	2777,8	19 951	55 419 888	15 394
Sep	2777,8	21 338	59 272 696	16 465
Oct	2777,8	20 134	55 928 225	15 536
Nov	2777,8	22 665	62 958 837	17 489
Dec	2777,8	23 325	64 792 185	17 998
Total [MWh]		242 286	673 022 051	186 951

Specific Enthalpy at 9bar gage pressure = 2777.8KJ/kg

Energy content from back up boilers

Month	Specific Enthalpy	Energy content		
	KJ/kg	t	MJ	MWht
Jan	2773,72	1 600	4 437 952	1 233
Feb	2773,72	1 114	3 089 924	858
Mar	2773,72	590	1 636 495	455
Apr	2773,72	1 002	2 779 267	772
May	2773,72	233	646 277	180
Jun	2773,72	2 009	5 572 403	1 548
Jul	2773,72	511	1 417 371	394
Aug	2773,72	744	2 063 648	573
Sep	2773,72	184	510 364	142
Oct	2773,72	670	1 858 392	516
Nov	2773,72	216	599 124	166
Dec	2773,72	405	1 123 357	312
Total [MWh]		9 278	25 734 574	7 148

Specific Enthalpy at 8bar gage pressure = 2773.72KJ/kg

Those tables above are with raw data from Monthly reports.
Heat produced from CHP and back up boilers is equal:

$$H = m * h /3600,$$

where
- H – heat (MWht)
- m – mass (t)
- h – specific enthalpy (KJ/kg)

Natural gas for CHP x1000 Nm3

Month	2004	2005	2006	2007	2008	2009	2010	2011	2012
Jan			1 773	4 264	4 426				
Feb			1 438	4 012	3 435				
Mar			1 929	4 465	3 507				
Apr			2 330	2 963	3 263				
May			1 511	3 759	3 590				
Jun			3 456	3 569	2 929				
Jul			3 499	3 877	3 949				
Aug			3 081	3 639	3 891				
Sep			0	4 011	4 166				
Oct			2 841	4 097	3 683				
Nov			3 683	4 299	3 899				
Dec		541	3 745	4 488	4 014				
Total (1000 Nm3)	**0**	**541**	**29 284**	**47 441**	**44 751**				

Generated electricity from CHP ;[MWhe]

Month	2004	2005	2006	2007	2008	2009	2010	2011	2012
Jan			5 258	14 065	14 021				
Feb			4 363	13 368	10 608				
Mar			5 314	14 660	10 811				
Apr			6 755	9 925	10 000				
May			4 585	12 334	10 971				
Jun			11 092	11 590	8 901				
Jul			11 170	12 487	12 239				
Aug			10 067	11 931	12 263				
Sep			0	13 054	13 205				
Oct			9 152	13 379	11 830				
Nov			11 847	14 093	13 393				
Dec		1 255	11 988	14 676	13 458				
Total (MWh)	**0**	**1 255**	**91 592**	**155 562**	**141 698**				

Exchange electricity from power grid (consuned from NEC,all); [MWhe]

Month	2004	2005	2006	2007	2008	2009	2010	2011	2012
Jan	8 598	8 631	5 573	8 432	9 429				
Feb	8 201	7 881	4 167	8 355	8 475				
Mar	8 305	8 586	4 101	9 386	8 924				
Apr	7 866	8 521	4 096	8 754	8 525				
May	8 335	9 004	6 624	9 273	8 564				
Jun	8 294	8 800	6 340	8 947	7 937				
Jul	8 890	8 552	6 635	8 571	7 077				
Aug	8 319	8 741	7 833	9 143	6 446				
Sep	7 806	8 408	7 998	8 823	6 000				
Oct	8 829	8 675	8 829	8 862	5 680				
Nov	8 880	8 187	7 656	8 894	6 205				
Dec	8 786	7 822	8 680	9 191	6 663				
Total (MWh)	**101 109**	**101 810**	**78 532**	**106 631**	**89 924**				

Exchange electricity to power grid (Sold to NEC) ;[MWhe]

Month	2004	2005	2006	2007	2008	2009	2010	2011	2012
Jan			1 994	13 811	13 721				
Feb			2 708	13 121	10 382				
Mar			3 212	14 394	10 685				
Apr			4 073	9 789	9 686				
May			3 657	12 114	10 746				
Jun			10 812	11 382	8 728				
Jul			10 971	11 597	11 923				
Aug			9 985	11 564	11 989				
Sep			0	12 815	12 880				
Oct			8 824	13 127	11 574				
Nov			10 839	13 879	13 076				
Dec		548	11 771	14 355	13 153				
Total (MWh)	**0**	**548**	**78 846**	**151 947**	**138 544**				

Net Energy content from CHP - to Biovet; [MWht]

Mont	2004	2005	2006	2007	2008	2009	2010	2011	2012
Jan			7 732	10 465	17 396				
Feb			5 517	10 606	14 941				
Mar			5 300	10 796	15 207				
Apr			4 794	5 890	12 266				
May			2 618	7 346	15 488				
Jun			5 063	7 487	12 205				
Jul			5 598	12 656	16 566				
Aug			4 514	12 089	15 394				
Sep				13 212	16 465				
Oct			4 450	13 516	15 536				
Nov			8 746	13 958	17 489				
Dec		1 479	8 378	14 421	17 998				
Total [MWh]	**0**	**1 479**	**62 711**	**132 441**	**186 951**				

Energy content from back up boilers; [MWht]

Mont	2004	2005	2006	2007	2008	2009	2010	2011	2012
Jan	16 849	15 412	6 524	767	1 233				
Feb	15 340	14 887	5 223	283	858				
Mar	15 040	14 453	2 689	228	455				
Apr	12 508	12 294	1 896	2 960	772				
May	12 071	12 038	4 313	1 484	180				
Jun	10 970	10 822	493	1 707	1 548				
Jul	11 239	9 312	663	715	394				
Aug	11 101	10 566	2 184	1 640	573				
Sep	10 776	10 170	7 493	540	142				
Oct	12 667	10 384	2 432	907	516				
Nov	13 378	10 874	1 365	333	166				
Dec	15 293	11 145	2 975	261	312				
Total [MWh]	**157 231**	**142 357**	**38 248**	**11 824**	**7 148**				

Efficiency of back up boilers (month mean value); [%]

Mont	2004	2005	2006	2007	2008	2009	2010	2011	2012
Jan	88	88	71	88	91				
Feb	88	88	80	88	88				
Mar	88	88	89	88	88				
Apr	88	88	88	88	88				
May	88	88	82	89	88				
Jun	88	88	88	88	88				
Jul	88	88	88	88	88				
Aug	88	88	88	88	88				
Sep	88	88	88	88	88				
Oct	88	88	88	88	88				
Nov	88	88	88	88	88				
Dec	88	88	88	88	88				
Average ;%	**88**	**88**	**86**	**88**	**88**				

LHV_{NG} Lower heating walue kkal/Nm3 -

Mont	2004	2005	2006	2007	2008	2009	2010	2011	2012
Jan			8 010	8 015	8 020				
Feb			8 008	8 013	8 013				
Mar			8 010	8 012	8 021				
Apr			8 010	8 014	8 021				
May			8 013	8 022	8 019				
Jun			8 018	8 021	8 019				
Jul			8 017	8 052	8 021				
Aug			8 011	8 028	8 044				
Sep			8 004	8 019	8 031				
Oct			8 009	8 018	8 031				
Nov			8 012	8 013	8 035				
Dec		8 000	8 015	8 030	8 079				
Average ;kkal/Nı	**0**	**8 000**	**8 011**	**8 021**	**8 030**				

The protocols with the filled data in the tables above are shown in Annex No. 4 to the Monitoring Report.

5. Calculations

The calculations of the emissions and the emissions reduction in the Monitoring model are performance automatically using the formulas outlined in point 2 of the Monitoring report and PDD.

5.1 Baseline emissions calculation

The calculations are based on formulas in point 2.4 and are executed with the Netherlands emissions factors in accordance with point 2.7 of the Monitoring report.

Baseline sceanrio

Base line calculations

LHV_{NG}	Lower heating walue	8 029,53 kkal/Nm3 -	NG mean value from BULGARGAS for 2008		
EF_{NG}	CO2 emissions factor (combustion)	56,1	tCO2/TJ	Natural gas	tCO2/TJ from the Netherlands guidelines for JI PDD

Emissions from produced heat

Year	Year	CHP heat to Biovet	Back up boilers enrgy content	Total energy content	Back -up boiler Efficiency	Energy content coefficient	Total heat NG input	CO2 emissions (combustion)
		MWh/year	MWh/year	MWh/year	%	%	TJ/year	t/year
1	2004	0	157 231	157 231	88,2	0	642	36003
2	2005	1 479	142 357	143 836	88,2	0	587	32936
3	2006	62 711	38 248	100 958	85,5	0	425	23847
4	2007	132 441	11 824	144 265	88,1	0	590	33077
5	2008	186 951	7 148	194 099	88,4	97,52	717	40197
6	2009	0	0	0	0,0	0		
7	2010	0	0	0	0,0	0		
8	2011	0	0	0	0,0	0		
9	2012	0	0	0	0,0	0		

Emissions from electricity

Year	Year	Electricity from CHP	Electricity to grid	Electricity from grid	Total el.consumption in BIOVET	EF	CO2 emission (electricity grid)
		MWh	MWh	MWh	MWh	kgCO2/MWh	t/year
1	2004	0	0	101 109	101 109	979	98 986
2	2005	1 255	548	101 810	102 517	957	98 108
3	2006	91 592	78 846	78 532	91 278	934	85 253
4	2007	155 562	151 947	106 631	110 247	912	100 545
5	2008	141 698	138 544	89 924	93 079	890	82 840
6	2009	0	0	0	0	867	0
7	2010	0	0	0	0	845	0
8	2011	0	0	0	0	822	0
9	2012	0	0	0	0	800	0

5.2 Project emissions calculation

The calculations are based on formulas in point 2.5 and are executed with Netherlands emissions factors in accordance with point 2.7 of the Monitoring report.

Project emissions CHP LM2000

LHVNG	Lower heating walue	8 030 kkal/Nm3 -		NG value from BULGARGAS for 2008
EFNG	CO2 emissions factor (combustion)		56,1	tCO2/TJ from the Netherlands guidelines for JI PDD

Emissions from combustion

Year	Year	Natural gas for CHP	CHP(NG-LHV) consumption	Back up boilers heat production	Back -up boiler Efficiency	Energy content coefficient	NG-LHV cons. back up boilers	Total NG heat input	CO2 emissions (combustion)
		x1000 Nm3	TJ/year	MWh	%	%	TJ/year	TJ/year	t/year
1	2004	0	0	157 231	88,2	0	642	642	36003
2	2005	541	18	142 357	88,2	0	581	599	33613
3	2006	29 284	982	38 248	85,5	0	161	1143	64118
4	2007	47 441	1 589	11 824	88,1	0	48	1637	91838
5	2008	44 751	1 504	7 148	88,4	97,52	26	1531	85864
6	2009	0	0	0	0,0	0			
7	2010	0	0	0	0,0	0			
8	2011	0	0	0	0,0	0			
9	2012	0	0	0	0,0	0			

Emissions from electricity

Year	Year	Electricity from CHP	Electricity consumed from grid	EF	CO2 emission (el. from grid)	Electricity to grid	EF	Avoided (-) CO2 emission (el. to grid)
		MWh	MWh	kgCO2/MWh	t/year	MWh	kgCO2/MWh	t/year
1	2004	0	101109	979	98986	0	832	0
2	2005	1255	101810	957	97432	548	814	446
3	2006	91592	78532	934	73349	78846	797	62 841
4	2007	155562	106631	912	97248	151947	779	118 367
5	2008	141698	89924	890	80033	138544	761	105 432
6	2009	0	0	867	0	0	743	0
7	2010	0	0	845	0	0	725	0
8	2011	0	0	822	0	0	707	0
9	2012	0	0	800	0	0	689	0

5.3 Emissions reduction calculations

The calculations are based on the formula in point 2.6 and are executed with emissions factors of the Netherlands in accordance with point 2.7 of the Monitoring report.

Reduction CO_2 emision

		Base Line		Project Line			Reduction
Year	Year	CO2 emissions (combustion)	CO2 emission (electricity grid) consumption	CO2 emissions (combustion)	CO2 emission (el. from grid)	CO2 emission (el. to grid) (-)	Total CO2 emission reduction
		t/year	t/year	t/year	t/year	t/year	t/year
1	2004	36 003	98 986	36 003	98 986	0	0
2	2005	32 936	98 108	33 613	97 432	446	445
3	2006	23 847	85 253	64 118	73 349	62 841	34 475
4	2007	33 077	100 545	91 838	97 248	118 367	62 903
5	2008	40 197	82 840	85 864	80 033	105 432	62 573
6	2009						
7	2010						
8	2011						
9	2012						

The calculations files are attached in Annex No. 4 to the Monitoring Report.