MONITORING REPORT

Kostenets HHI JSC

01 September 2010 – 31 October 2012

JI PROJECT

COGENERATION GAS POWER STATIONS
AKB FORES PLC Financial Industrial Group

Sofia, November 2012

Bulgaria

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Abbreviations used

ABECng	annual baseline natural gas energy consumption	GJ/y
AECng	annual natural gas energy consumption by CHP	GJ/y
EIA	Environmental Impact Assessment	
AFCng	annual consumption of natural gas	Nm^3
AOH	annual operational hours	h/y
BEelec	baseline CO_2 emissions by electricity supplied by CHP	tCO_2/y
BEth	baseline CO_2 emissions offset by CHP heat output	tCO_2/y
BEtotal	total baseline emissions (CO_2 equivalent)	t CO_2 eq/y
BEF elec	baseline CO_2 emissions factor for electricity from grid	$kgCO_2/MWh$
CAHO	CHP annual heat output	GJ/y
CGS	Co-Generation Gas Power Station	
CHOR	CHP heat output rate	GJ/y
CHP	Combined Heat and Power	
CEO	annual CHP electricity output	MWh/y
CPO	CHP net power output capacity	MW_e
DHC	District Heating Company	-
DSWG	Distribution switchgear	
LCV, LHV	lower calorific (heat) value of natural gas	$kcal/m^3$
e_b	industrial boiler efficiency (LHV basis)	%
Ecs	CO_2 emissions per year from natural gas combustion in CHP	t CO_2/y
Eeq met comb	CO_2 equivalent of methane emissions from natural gas combustion	t CO_2 eq/y
EL	Energy Law	
Emet comb	methane emissions from natural gas combustion	tCH_4/y
Etotal	total project GHG emissions	t CO_2 eq/y
EFel gen	emission factor for electricity generation	$kgCO_2/kWh$
EF ng	CO_2 emission factor of natural gas	kg CO_2/GJ
EIRcog	energy input rate to CHP	GJ/h
ER	emission reduction from project activities	t CO_2 eq/y
EU	European Union	
GWP (CH_4)	global warming potential of methane	21 – Kyoto protocol
MCEO	monthly electricity output of CHP	MWH/month
MCHO	monthly heat output of CHP	GJ/month
MECng	monthly ng energy consumption of CHP	GJ/month
MEF	methane emission factor for ng combustion	$kgCH_4/TJ$
NEC	National Electric Company	
NPS	Nuclear Power Station	
NSI	National Statistics Institute	
RES	Renewable Energy Sources	
SEC	specific energy consumption for power generation	kJ/kWh
SWERC	State Water and Energy Regulation Committee	
TPS	Thermal Power Station	

1. Introduction

The Monitoring report is prepared in accordance to paragraph 36 of the JI guidelines and is based on the JI - Project Design Document. The present monitoring report provides complete, consistent, clear, and accurate calculation of the emissions reductions, within the boundaries of Kostenets HHI subproject, included in the PDD, for the period 1st September 2010 – 31st October 2012.
Reference number of the present Monitoring Report is 002.
Version number of the present Monitoring Report is 02/13.12.2012.

1.1 Project participants

The project principal was:
AKB Fores PLC.
Financial & Industrial Concern
20, F.J.Curie Str.
1113 Sofia, Bulgaria
Website: www.akbfores.com

GHG reductions supplier:

Kostenets – HHI JSC,
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2030 Kostenets, Bulgaria
Wesbsite: www.hhi-bg.com

Company – developer of Project Design Document

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Company – developer of Monitoring Report

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Wesbsite: www.cogeneng-bg.com
Mr. Pavel Sotirov – Executive Manager

1.2 Project location

The mother project comprises the design, construction, and operation for a portfolio of three highly-efficient gas power stations with a total power capacity of 22.3 MWe CHP type generation of electric and thermal power at Polimeri Devnia, Kostenets –HHI and Toplofikatsia Kazanlak.
The projects locations are shown on the map below and are executed in the following plants:

Kostenets HHI JSC is located in town Kostenets about 70 km from Sofia in south direction. The settlement into thepresent day municipal centre Kostenets started in 1884 but officially from 1964. Its population is about 15 300 inhabitants of which 60 % in employable age. Kostenets is situated at 508 m attitude at the foot of East Rila Mountain. The average temperature is between – 5º C and +22 º C. The type of the cogeneration is the same like in Polimeri Devnia. The cogeneration site is closed to the existing thermal station.

1.3 Background

Bulgarian energy sector is undergoing a rapid change, mostly driven by EU accession of Bulgarian. The Ministry of Energy is privatizing the energy generation capacity in the country. At the same time, the energy market is in the process of liberalization. This means that subsidies for households and industrial users are gradually removed (they are now already almost 100% removed) and prices for energy therefore have increased in will continue to increase on the base of generation capacity decreasing connected with

the 3rd and 4th blocks of the nuclear power plant "Kozloduy" decommissioning. The factories in Bulgaria that use energy are looking for ways to reduce costs for energy and to maintain the security of supply of energy to their production processes. They start to invest in own generation capacity. Factories that currently produce energy are looking for ways to increase their efficiency to become more competitive in this liberalized and privatized market. The investments that these companies make in order to start generating energy or to become competitive are significant.
The investment economics of the CHP portfolio is enhanced by the possibility of selling the reduction of CO2 emissions to the ERUPT programme. At the same time, the Bulgarian government has adopted for the encouragement of investments in combined energy production by compulsory purchasing of the produced electric energy at preferential prices.

Project activities at Kostenets HHI

The Kostenets HHI pulp and paper factory replaced the use of heavy fuel oil with the use of natural gas through the investment in the new CHP. This new CHP also increases the efficiency and reduces the costs. Both factories secure the supply of energy to their production processes with these new CHPs. They also stabilize the price of electrical and the thermal energy around the present values for comparatively long period.

The realized highly efficient CHP plant will resolve the following issues for the factory of Kostenets:

- The installation will provide a safe and clean secured supply of heat and electricity needed for the production processes in the factory.

- The new cogeneration modules will provide competitive generation of electricity and steam. This will result in cost reduction for the core business of the factories.

- The new facility provides a better flexibility to adapt the needs of the production process while keeping efficiency at an attractive level.

- The environmental conditions at the factory and the region will be improved;

1.4 Description of the Project activities

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

Fig.1.4.1 – Cogeneration installation at Kostenets HHI common view

The installations at Kostenets are with gas turbine modules.
The main Cogeneration Gas Power Station equipment in Kostenets comprise gas turbine modules and Heat Recovery Steam Generators:
The main technical parameters of the gas turbine gensets are shown in table No.1 below:

Parameters	Dimens.	Cogen Sets Kostenets
Number of gensets		2
Gas Turbine Type		Rolls-Royce Allison 501 KB5 Simple cycle, single shaft
Year of production		2007
Producer		Centrax LTD, England
Electrical power /installed/	[MWe]	3.79
Fuel – Natural gas LHV	[kJ/kg]	49252
Fuel consumption	[kJ/KWh]	13208
Exhaust gases temperature	ºC	560
Exhaust gases flow	[kg/s]	15.6
Turbine axial compressor - stages compression ratio		14 9.175:1.0
Turbine – stages		4
Speed	[rpm]	14571
Weight	[kg]	577
NOx control –Water	[kg/s]	0.16
Generator Type		Synchronous LSA 56 BUL85 4P
Year of production		2007
Producer		Leroy Somer
Rated Voltage	[kV]	6.3
Rated Frequency	[Hz]	50
Rated Power	[MWe]	5.9
Speed	[rpm]	1500
Power Factor		0.8

Table 1.4.1- Kostenets gensets main technical data

The genset has situated on common frame in acoustic container. The container is for outdoor application. The container is equipped with automatic antifire system. The inlet filters, ventilation and lube oil cooling system are situated oh the roof of the container.
NOx requirements are 75 mg/Nm^3 at 15% O_2. To meet the NOx requirements, in the combustion chambers are injected water, to decrease the burning temperature. The water for NOx control is with dept treatment to cover the requirements of Rolls Royce and shall be provided by additional stage of the boiler's Water treatment plant.
The Heat Recovery Steam Generator (HRSG) is designed to provide the required amount of steam, at the required pressure and temperature, and quality levels.
The boilers are equiped with additional burners to ensure the whole quantity of necessary steem.

The main technical parameters of the boilers are shown in the table No.2 below:

Parameters	**Dimens.**	**HRSGs Kostenets**	
Boilers		Boiler 1	Boiler 2
Type		HRSG/one pass boiler/	
Year of production		2007	
Producer		Ambitermo, Portugal	
Exhaust gas flow at 100%MCR/15ºC	[kg/h]	56160	
Exhaust gas temperature inlet	[º C]	535	
Condensate	[%]	70 at 70 ºC	
Inlet water temper. to economizer 1 and 2	[ºC]	20	
Waste Recovery Only at 100% MCR / 15ºC			
Gross steam	[t /h]	10.05	10.05
- Temperature	[ºC]	210	210
- Pressure	[barg]	18	18
Technological steam	[t /h]	9.75	9.75
- Temperature	[ºC]	210	210
- Pressure	[barg]	18	18
De-Aerator steam	[t /h]	0.3	0.3
Exhaust gas temperature outlet	[º C]	126	126
Waste Recovery + Post Combustion at 100% MCR / 15ºC			
Burner Heat Input /Natural Gas /	[MWht/h]	3.80	3.80
Gross steam	[t /h]	15.99	15.99
- Temperature	[ºC]	210	210
- Pressure	[barg]	18	18
Technological steam	[t /h]	15.00	15.00
- Temperature	[ºC]	210	210
- Pressure	[barg]	18	18
De-Aerator steam	[t /h]	0.99	0.99
Exhaust gas temperature outlet	[º C]	`122	`122

Table 1.4.2 – Kostenets Heat Recovery Steam Generators main technical data

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. Implementation of the project

The project implementation is shown in the table below:

No	Name of activity	Terms of execution
1	Start of the project	01.04.2005
2	Project detail design	11.2006 - 09.2007
3	Construction on site	01.2008 - 07.2008
4	Equipment delivery	12.2006 - 03.2008
5	Equipment installing	04.2008 - 08.2008
6	NG supply providing	06.2009
7	Operation tests	07.2009 - 08.2009
8	Commissioning	08.2009
9	Start of operation	01.09.2009

Table 2.1.1 – Implementation of the project

The operational lifetime of the project is shown in the table below:

	Project Kostenets HHI JSC
Operational lifetime	**20 /twenty/ years or 240 months**

Table 2.1.2 – The project lifetime

2.2. Intended deviations or revisions to the registered PDD

In the mother project there were 4 subproject. All Subprojects commissioning has been delayed in comparison to the foreseen schedule in the PDD due to delays with work.
The subproject "Toplofikatsia Yambol JSC" was rejected during implementation period as not feasible project due to finacial reasons.

	Subproject	Start of construction as per PDD	Commissioning date as per PDD	Commissioning date
1	Polimeri JSC	11.2005	01.01.2007	Not operational yet
2	***Kostenets HHI JSC***	***11.2005***	***01.01.2007***	***01.09.2009***
3	Toplofikatsia Kazanlak – Boilers	11.2005	01.01.2007	01.01.2008
4	Toplofikatsia Kazanlak – Inst.1	11.2005	01.01.2007	01.01.2008
5	Toplofikatsia Kazanlak – Inst.2	11.2005	01.01.2007	Not operational yet
6	Toplofikatsia Yambol	11.2005	01.01.2007	Rejected project

Table 2.2.1 – Intended deviations to the registered PDD

Remark:
Now the situation with the project is for official dividing of the whole project on two projects, Kostenets HHI project and Polimeri +Toploficatsia Kazanlak project. The main reason is that the owner structure is changed and Kostenets HHI has another owner.
In this Monitoring report like GHG emissions reduction supplier participate only Kostenets HHI JSC.

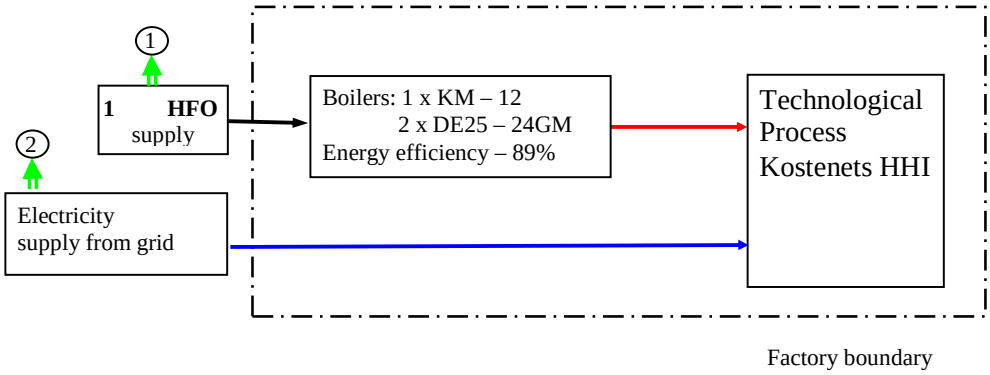
2.3. Intended deviations or revisions to the registered Monitoring Plan

The determined PDD was prepared to reflect requirements of the specific "Senter Novem" methodology. All formulas for calculation of the baseline and project emissions as far as emission reductions was included in Section 6 – Identification of the most likely Baseline Scenario and the associated greenhouse gas emissions. In the Monitoring Report these formulas are placed in Section 3 – Methodology.
There are no significant deviations or revisions to the registered MP. All changes that occur intend to ensure more clear and simple approach of data calculation. The other reason is avoiding the calculation of the intermediate results.

1. In PDD, annual baseline emissions from electricity supplied by grid BEl is calculated as multiply of annual baseline electricity consumption ABEC and baseline emission factor for electricity from grid. In the present Monitoring Plan instead of ABEC is used the difference of two measurements (CEO – AEI), where CEO is annual electricity production of CHP and AEI is annual electricity export to NEC grid. In fact **ABEC = CEO – AEI**.
2. In PDD, project emissions, caused by the use of backup boilers (where applicable) are calculated only for natural gas fuel. In fact these backup boilers can work with secondary emergency fuel – HFO. In the present Monitoring Plan in the calculation of those emissions is introduced possibility of HFO based use of backup boilers. To the initial equation $\mathbf{PE_{bb} = BBEC_{NG} * EFng}$ **was included additional member** $\mathbf{(+ BBEC_{HFO} * EF_{HFO})}$.

During the initial and first verification, the AIE was positively determined these revisions.
After the initial and first verification no revision has been made.

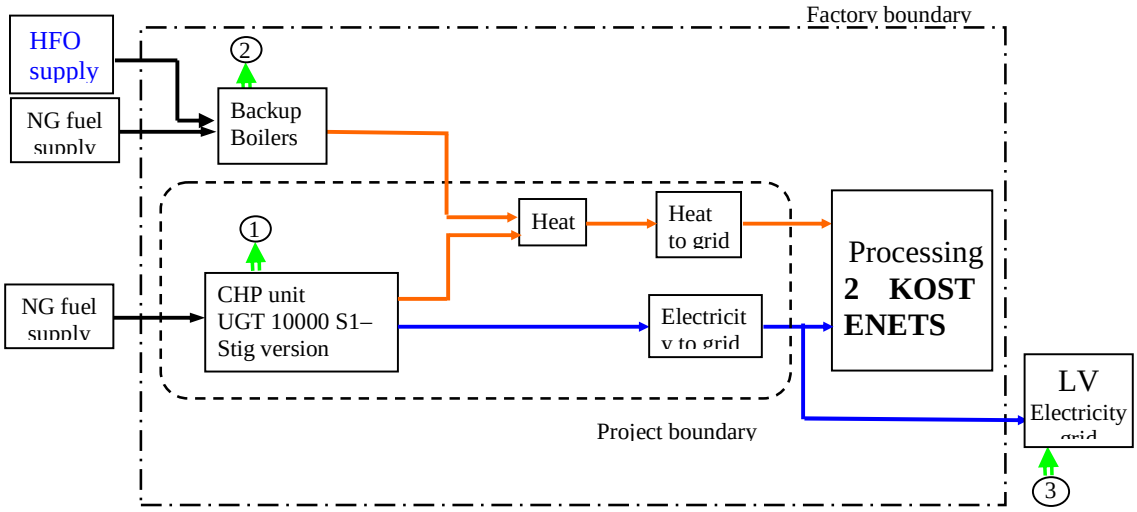
Flowchart of the situation before the implementation of the project – separate generation of heat and electricity.



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

Fig. 2.4.1 -Flowchart of current delivery system with it's the main components and their connections for Kostenets HHI.

2.5. 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 – Indirect off-site CO_2 avoided emissions (electricity to grid)

Fig. 2.5.1 - Flowchart of the situation after the implementation of the project at Kostenets HHI

Direct and indirect emissions

With this definition of the project boundary, the Project and Baseline emissions, both *On-site and Off-site* are as shown in Table 2.5.2.1:

On-site emissions			
Project	**Current situation**	**Direct or indirect**	**Include or exclude**
CO_2 emissions from NG combustion in CHP		Direct	Include
	CO_2 emissions from HFO combustion in boilers	Direct	Include
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 electricity grid	Direct	Include
CO_2 avoided emissions to Electricity grid		Indirect	Include

Table 2.5.1 – On-site and Off-site, Direct and Indirect, Project and Baseline emissions at Kostenets HHI

2.6. Estimation of the baseline emissions

Baseline emissions can be collected in the "direct on-site" and "direct off-site" categories and comprise the following components:

- **CO_2 combustion** existed boilers provided heat to the plant.
- **CO_2 electricity –** emission associated with the electricity that would have to be purchased from the power grid in order to cover power demand of the plant

In order to estimate the importance of the project realisation upon the CO_2 emissions, the following estimation are prepared:

- estimation of the baseline CO_2 emissions scenario;
- estimation of the CO_2 emissions from the CHP project;
- reduction of the CO_2 emissions as a result from the project realisation.

The quantity of CO_2 emissions may be expressed by multiplication of emission factor and corresponded energy consumption.
Especially For the second baseline emission component: **CO_2 electricity –** these emissions associated with the electricity from the power grid and depend on CO_2 emission factor for Sector electricity producing from the Industry of Bulgaria. In case of impossibility to use this EF than shall be used the predicted values /BEF_{el}/ presented in "Operational guidelines for Project Design Document of JIP" – Ministry of Economic Affairs of the Netherlands, May 2004
The Bulgarian electricity emission factors shall be calculated and verificated ex-post annually and officially published on Bulgarian MOEW Web page. The looses of electrical energy in the state network is

with source Bulgarian National Statistical Institute for the past year and also shall be included in the verificated report of MOEW.

The Netherlands emission factors values from the "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 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

The quantity of CO_2 emissions may be expressed by multiplication of emission factor and corresponded energy consumption. Emission factors are determined by:

1) For the first baseline emission component: **CO_2 combustion** is associated with the combustion of HFO in existed boilers; the emission factor for HFO is EFmg = 0.0774 Kton/TJ – IPCC 2006.

2) For the second baseline emission component: **CO_2 electricity** – look the text in point 2.6 above.

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

$$\mathbf{ABNG = ABHEC / e_b, \quad TJ/y}$$

Where: e_b – boiler efficiency, determined from engineer's analyses.
ABHEC – annual heat consumption in Kostenets Plant, TJ/y

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

$$\mathbf{BE_{th} = ABNG * EF_{HFO}, \quad t\ CO_2/y}$$

Where: EF_{HFO} = 0.0744 Kton CO_2/TJ – emission factor for HFO combustion in boilers

The baseline estimations of annual CO_2 emissions from electricity produced from CHP and supplied to technological process and to power grid – BEl are given by:

$$\mathbf{BEl = (CEO-AEI)* BEF_{el} / 1*10\text{^}^6, \quad t\ CO_2/y}$$

Where: CEO [MWh/y]– annual electricity production of CHP in Kostenets.
AEI [MWh/y] – annual electricity export to NEC grid.
BEF el [gCO_2/kWh] – annual baseline emission factor for electricity from grid.

Total baseline emissions are:

$$\mathbf{BE_{total} = BE_{th} + BEl}$$

The results are presented in monitoring model – File Monitoring PDD Kostenets HHI.xls.

2.7. Estimation of the project emissions

The following estimation procedure is used for estimation of CO_2 emission in the project boundary:

- **Direct on-site emissions into the project boundary are caused by NG combustion in CHP.**

Annual NG energy consumption from CHP and Additional burners , AEC ng, is is read from the measurement devices /Gas Flowmeters/ on Month base:
Direct on-site CO_2 emission from NG combustion in CHP - PE_{CHP}

$$\mathbf{PE_{CHP} = AEC\ ng * EFng}$$

- **Direct off-site emission according to project boundary are caused by NG and HFO combustion in back up boilers –PE_{bb}, are estimated as:**

The difference between annual baseline heat energy consumption in Kostenets Plant- ABHEC and annual heat energy output from CHP - CAHO is equal to annual back up boilers heat energy output – BBH. The quantity of the used fuel natural gas $BBEC_{NG}$ and reserve fuel HFO – $BBEC_{HFO}$ are measure with measurement devices on monthly base in the year:

The Direct off-site CO_2 emission from NG combustion in back up boilers - PE_{bb} are calculate by formulae:

$$\mathbf{PE_{bb} = BBEC_{NG} * EFng + BBEC_{HFO} * EF_{HFO}}$$

CO_2 emissions, avoided from the replaced electricity is PErgrid. The negative difference between annual baseline electricity consumption of Kostenets HHI – ABEC and annual electricity output of CHP – CEO show that AEI is el.production for selling, which replace the electricity to grid for Kostenets HHI. The positive difference no matter for the project because normally participate in baseline and project emissions with equal values and signs. The effect is zero.

$$\mathbf{AEI = ABEC – CEO,\quad MWh/y}$$

Where: AEI - annual electricity export to NEC grid, MWh_e.
ABEC – annual electricity baseline consumption of factory, MWh_e
CEO - is annual electricity output of CHP, MWh_e

Indirect off-site avoided CO_2 emission - replaced electricity to grid - PE_{grid}

$$\mathbf{(-)\ PE_{r_{grid}} = AEI * EFel_{,gen}}$$

Where: FEel,gen – is emission factor for generated electricity in Bulgaria

Total CO_2 emissions from the project implementation are:

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

The project emissions results are presented in monitoring model – File Monitoring PDD Kostenets HHI.xls.

2.8. Estimation of CO_2 emission reductions

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

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

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

The emissions reduction results are presented in monitoring model – File Monitoring PDD Kostenets HHI.xls.

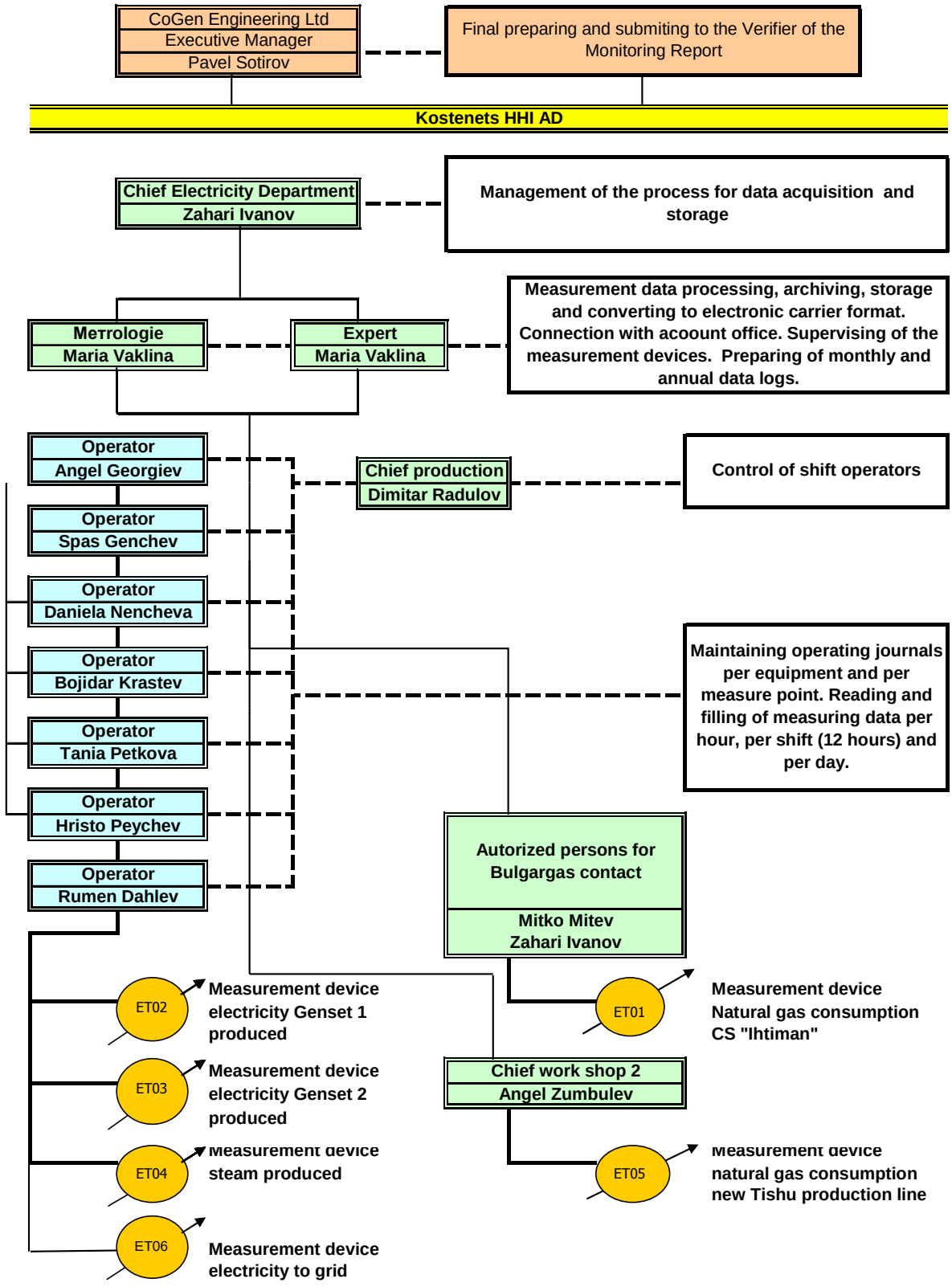
3. Monitoring

This project comprises the installation of a natural gas-fired cogeneration systems at 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 Organization charts for data monitoring and reporting

Persons involved in data monitoring and reporting at Kostenets HHI CHP
The organization chart of the persons, involved in the monitoring process during the present period for Kostenets HHI AD is given below:

Monitoring organization chart



3.2 Key Monitoring activities and Data monitored

The data are and will be collected on a monthly basis during the crediting period (including 2012). The CO_2 emissions following the project implementation are determined from the parameters monitored, as described above. The monitoring plan describes the procedures for the collection of the data, and the procedures for the auditing required for the projects, in order to determine and verify emissions reductions achieved by the project. These projects will only require straightforward collection of data, described below.

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

- Natural gas used by the cogeneration plant and back-up boilers, in Nm^3.
- The net electricity supplied by the cogeneration plant to the factory, in MWhe.
- The electricity exported to the grid, in MWhe.
- Net heat supplied by cogeneration plant and back-up boilers to the factory, in GJ.
- The HFO used for the back up boilers in case of the secondary (emergency) fuel use.

The parameter "Current efficiency of the boiler(s) providing heat to the factory, in %" is not measured because such measurement is not necessary (is not included in the calculations). The reason is that efficiency of the boilers, using HFO is quite different than the efficiency of the same boilers, using natural gas. In fact for correct calculating of the Baseline scenario we need HFO efficiency of the boilers. That why we use the historical data from 2004. The values are shown on page 80 of the approved PDD.

For the specific project considerations in the PDD, a monitoring model has been designed. It is prepared in excel format in spreadsheets. With minimal changes, this model is applied to all three cogeneration projects included in the PDD. The monitoring models take the monitored data as input. They automatically calculate both project and baseline emissions, for each year following project implementation, in a dynamic mode. The model contains electronic CO_2 monitoring and calculation worksheets for the cogeneration projects. The electronic worksheets serve as a data management and analysis system for the project managers and operators, and can be used throughout the lifetime of the project. The staff, responsible for Project monitoring, is required to complete the electronic worksheets on a monthly basis. This model automatically provides the annual totals in terms of Greenhouse Gas reductions achieved through the implementation of the cogeneration systems.

The Excel monitoring model also determines the emissions associated with cogeneration system.
The model contains a series of worksheets with different functions.
The monitoring methodology and its application is compatible with the baseline methodology and the development of the baseline scenarios developed for these projects. The assumptions regarding heating value and emissions factors for used fuels are the same in each case, and are unchanged throughout the project. These factors are country specific and listed in the PDD.

	Data type	Data variable	Data unit	Measured (m), calculated (c) or Estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data archived? (electronic/paper)	How long will the archived data be stored?
1	Volume of natural gas consumed by CHP and back up boilers	V NG	Nm^3	m	Monthly	100%	Paper (field record) Computer (spreadsheet)	Paper 1 yr Computer 7 years
2	Co-generation of electricity to industrial plant	ECHP	MWh	m	Monthly	100%	Paper (field record) Computer (spreadsheet)	Paper 1 yr Computer 7 years
3	Heat generation from CHP and back up boilers to industrial plant	Q_{heat}	MWh	m	Monthly	100%	Paper (field record) Computer (spreadsheet)	Paper 1 yr Computer 7 years
4	NG - Lower heating value	LHV	kJ/Nm^3	e	Monthly	100%	Paper (field record)	Paper 1 yr
5	Electricity exported to the grid	Eg	MWh	m	Monthly	100%	Paper (field record) Computer (spreadsheet	Paper 1 yr Computer 7 years
6	HFO - Lower heating value	LHV	kJ/kg	e	Monthly	100%	Paper (field record)	Paper 1 yr
7	HFO combusted in back up boilers	Gm	Tons	m + e	Monthly	100%	Paper (field record) Computer (spreadsheet	Paper 1 yr Computer 7 years
8	Boilers efficiency	η_B	-	e The value is from PDD on the base of engineer's analyses	Once in the crediting period	100%	Paper (field record)	Paper 1 yr Computer 7 years

Table 3.1.1 - Data to be collected in order to monitor Greenhouse Gas emissions from the project activities, and how these data will be archived

	Data type	Data variable	Data unit	Value	Source of data
1	Low heat value of Bulgarian Natural Gas	LHV_{NG}	$kcal/Nm^3$	**8 027**	Average value for year 2008. Data extracted from BulgarTransGas monthly certificates.
2	Low heat value of HFO	LHV_{HFO}	GJ/t	**39.80**	Data taken from Bulgarian National Inventory Report 2009 for GHG, page 167
3	CO_2 emissions factor from combustion of Natural gas (dry)	EF_{NG}	kg/GJ	**56.1**	Data taken from IPCC 2006 Volume 2 – Energy Table 2.2, page 2.16
4	CO_2 emissions factor from combustion of HFO	EF_{HFO}	kg/GJ	**77.4**	Data taken from IPCC 2006 Volume 2 – Energy Table 2.2, page 2.16
5	CO_2 emissions factor for electricity generation	$EF_{ELgen.}$	tCO_2/MWh	**0.761**	Value for year 2008 Data taken from Netherland Guidness B4 or alternatively ex-post from official Bulgarian EF
6	CO_2 emissions factor for electricity consumption	$BEF_{ELcons.}$	tCO_2/MWh	**0.89**	Value for year 2008 Data taken from Netherland Guidness B4 or alternatively ex-post from official Bulgarian EF

Table 3.1.2 - Constants and Default Data Values used in monitoring calculation

The structure and the procedures of monitoring in the period of project operation are:

Staff at project site

- Collecting and recording /electronically and in jourrnal/ hourly and monthly the data from electro meters;
- Collecting and recording /electronically and in jourrnal / monthly the data from NG and HFO flow meters and steam heat meter;
- For all subprojects monthly to send to the Operator the data collected and copies from the purchasing protocols and invoices;
- Monthly to collect the protocols of LHV from Bulgargas and HFO suppliers (if there is HFO consumption) or use the default value as per IPCC;

Staff at Operator

- The staff in charge of the monitoring shall fill the spreadsheets every month;
- To collect data from MOEW estimated and verificated grid EF annually;
- To calculate using the existing monitoring model the emission reduction annually;
- To prepare annually Monitoring report and to send to the independent verification entity.
- To control the organization of the subprojects staff training every two years.

Remark:

1. The monitoring process is supported from the implementation of one especially developed document “Journal of the measurement device”. In this journal are collected all necessary data for every one measurement device position from the measurement scheme of the separate plant in paper and electronic variant. The journal comprise the next sections with data: - Measurement

device QA/QC ensure, Thechnical description, Measurement device calibration, Training of the measurement device service, The procedures description in case of damages and temporary replacing of the measurement device, Measurement results (daily in the period 2006-2012). The filling of the journal is obligation of the staff at the plants. The final processing with the journals is obligation of the operator. The form of the "Journal of the measurement device" is available on request and the filled journals shall be presented to verification company in the process of verification.

2. The spreadsheets with the input data, calculations and results for the baseline and projects emissions are presented in Annex 1.

3.3 Measurement scheme and measurement devices

The measurement block schemes 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 and short description of the measurement devices are given below :

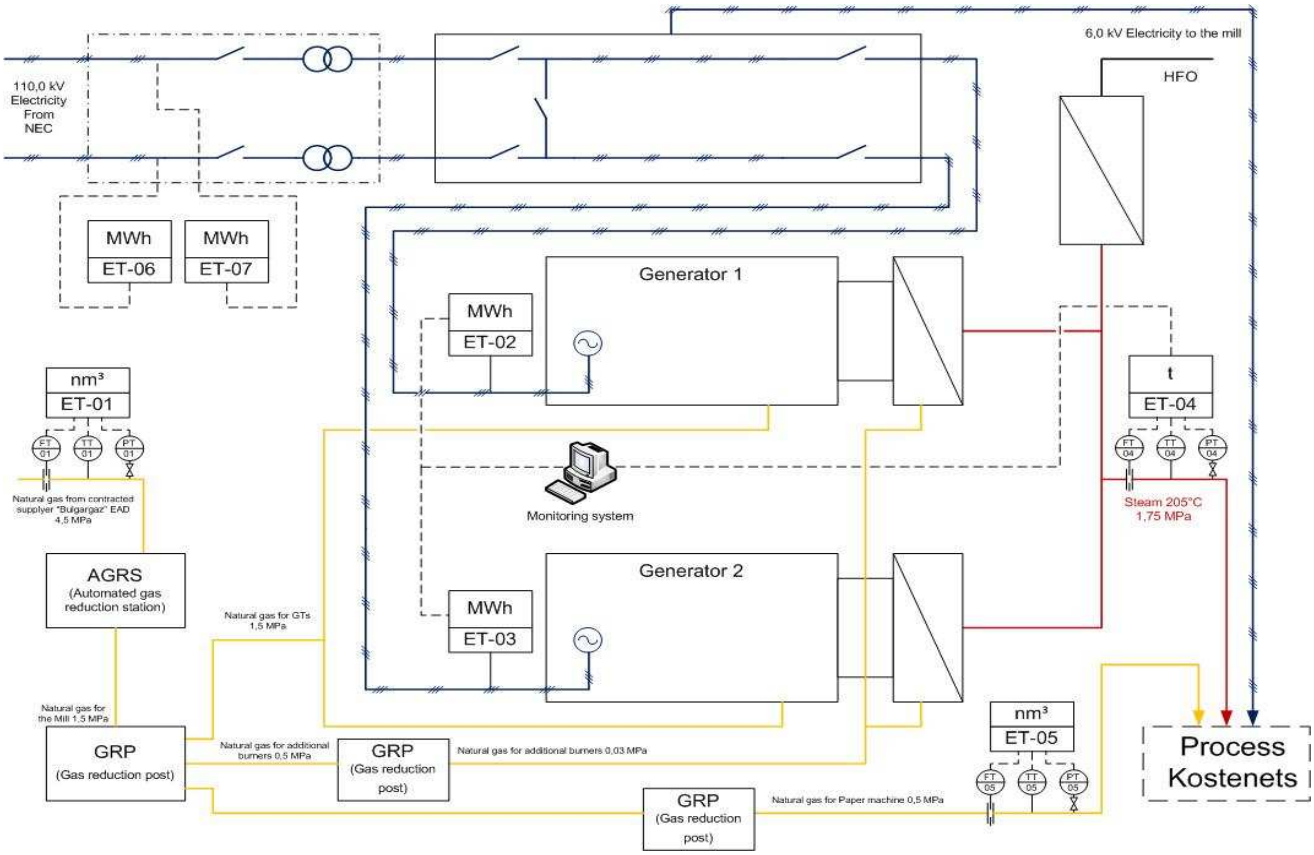


Fig. 3.3.2 - Measurement scheme at Kostenets HHI CHP

Position on the measurement scheme	Measured Parameter		Measurement method	Measurement device model Serial No. Period of measurements	Measure ment range	Accuracy %	Calbr. Period /years/	Calibr. protocols
	Parameter	Dimension						
1	2	3	4	5	6	7	8	9
ET-01*	Natural gas to the plant	Nm³	Turbine with P and T°C corrections	FLUXI2080TZ , Acraris S.N.7604602002/R 04.09.2009- 22.07.2011	Size = G160 Q= 13-250 m³/h Pmax= 100bar DN 80	- 0.18 to + 0.7	2	No. CT982?03 – 06.10.2008
				TRZ2 , Elster S.N. 80078779 from 22.07.2011	Size = G100 Q= 8-180 m³/h Pmax= 100bar DN 80	-0.04 to + 0.06	2	No.CT096/11 - 16.02.2011
				Electronic totalizer Unisyst CF 300T2 – V7,61- S.N. 0968/2006 from 04.09.2009	In accordance with FLUXI2080TZ and TRZ2	t=0.02 P=0.01	2	No. 460 - 24.07.2009 No. 645 - 25.07.2011
				DELTA 2050, Actaris S.N. 8601804004 14.06.2010 - 06.12.2010	Size = G40 Q= 1.3-65 m³/h Pmax= 94 bar Pn = 16 bar DN 50	- 0.91 to + 0.3	2	No.CR1075/08 - 26.11.2008
				DELTA 2050, Actaris S.N. 8601804003 from 06.12.2010	Size = G40 Q= 1.3-65 m³/h Pmax= 94 bar Pn = 16 bar DN 50	- 0.91 to + 0.3	2	No.CR1240/10 - 26.11.2010
				Electronic totalizer Unisyst CF 300T2 – V7,61- S.N. 0969/2006 from 14.06.2010	In accordance with DELTA 2050	t=0.02 P=0.01	2	No. 462 - 24.07.2009 No. 644 - 25.07.2011
ET-02	Electricity to grid of plant	MWh	Electronically Scheme 3 transformers	A 2000, GMC-I Gossen Metrawat S.N. RA4163000001 From 04.09.2009	MR=0 - 6 MWh CTs=3x750/1A VTs=3x6600/110V 230V, 50Hz,15VA IP52, IP30, IP20 0-20 mA, 0-10V, Dig. -2, Relay-2 Amb..- 0- 50°C RS 232, RS 485	± 0.5	4	No.27788 000010 / 29.01.2007 By DIN 55350-18-4.2
ET-03	Electricity to grid of plant	MWh		A 2000, GMC-I Gossen Metrawat S.N. RA4163000003 From 04.09.2009				
ET-04	Steam to the plant	t	Vortex with P and T°C compensation	PROWIRL 72F- DN 150 -Vortex flow measuring, Endres+ Hauser S.N. 9609C102000 from 04.09.2009	Vmax =75 m/s Tamb=-40-+70ºC Tproc.= -200-400ºC Suppl =24VDC,1.2W Degree.pr.= IP 67 Outp.4-20mA,HART K.fact.-0.3-0.4 pul./dm³	- 0.31 to + 0.18	2	No. 53401098 Endress+Hauser, 72FIF-SE1A A1AAA4AA- 02.07.2007

1	2		3	4	5	6	7	8
				Pressure Sensor-Cerabar M, PMC41-RE21S1H11M1-Endres+ Hauser S.N. 96075A01020 from 04.09.2009	Pressure - 0-40 bar;Process temp. to 100°C; Amb.temp.- - 40 - +85° C; Threaded connection, Output - 4-20 mA.; Supply voltage - 11.5 - 45 VDC	- 0.018 to + 0.05	2	No. 55475-08/60013131 /0020 Endress+Hauser 02.07.2007
				Steam Computer for Industrial Aplications RMS 621	Power Supply - 230 VAC, 50 Hz; Power consump. 8 - 26 VA; Amb.temp - -20 - +60 º C; Protect. - IP20; Inputs- 1x4-20mA-steam flow, 1x4-20mA pressure, 1xPt100-temperature; Outputs - 2x0/4-20mA, 1xPulse, 1xRelay; Interface - RS 232, RS 485.	-	-	-
ET-05	Natural gas to Tissue Machine	Nm³	Orifice with presure transmiter and Pt 100	Pressure sensor 267 CS, ABB Automation Products GmbH - Minden, S/N 267CS6502011 043SN. from 19.04.2011	Meas.range- 0.01 – 20bar; Transmiter – Amb. Temp. - 40º - + 85ºC-LCD Display- 20º-+70ºC; Power Suppl.-24 VDC; Flow rate 650 m³/h; Output 4-20mA-HART; Orifice Plate Stadard- Flanges, Material 316SS, Element bore - 89.325 mm, Pipe DN 150, Uncertanly – Disch.coef. ± 0.5% Expan.fact. ± 0.11%	± 0.075	4	No 76808-FE-01- Date 02.12.2008
					Stainless steel; conn. head BUZ; Sens. Sign. 4-20 mAHARTcomun; explosion class- ATEX II G Eex ia IIC T6 to T1 zone 0,1,2.; safety - SIL level 2;Temp. range - 50 - 400ºC.	Uncertantly ± 0.16	4	Certificate of compliance - 12-2009- Date 04.02. 2010
ET-06**	Electricity to grid of Chez	MWh	Electronicall Scheme 3 transformers	–	–	–	–	–

* -The values measured are corrected to normal temeperature (20°C) and pressure(1.01bara) in the flow computer of ET-01.
** - The factory has not exported electricity to grid to this moment. Now the factory realizes new connection with the distribution grid on 20 kV voltage level. There will remain only position ET-06.

Table 3.3.2 - Short measurement devices description Kostenets HHI CHP

Detail description of the measurement devices (technical, calibration, training, QA/QC procedures etc.) can be seen in the Measurement Journals of the Measurement Devices Annex No.3 for each plant.

Remark
By the reason of the calibration delay of measurement position ET 04 from 02.07.2009 to 31.10.2012, the calculations of the produced steam in the calculation file at Annex 1 to the Monitoring Report for twe whole period of this report, are corrected with the positive eror of measurement devices 72 F and PMC41 or with + 0.18% + +0.05% = +0.23% in negative direction.

3.4. QA/QC Procedures

In principle all procedures for the Quality Control and Quality Assurance of the measurements are presented in the legislation documents (norms and standards) as follow:

- Measurement Low – S.G., issue No 99 /09.12.2005 year;
- Order for measurement devices, which must have metrological control – S.G., issue No 98 /07.11.2003 year;
- Regulation for ordering of the competent persons how to verify measurement devices, which are under metrological control – GD N31 /12.03.2003 year;
- SAMTS (State Agency for Metrology and Technical Surveillance) order N A-413/16.08.2004, A-102/05.03.2010, A-441/13.10.2011 for the periodical testing of measurement devices, which are subject of metrological control.

The procedures for installation and maintenance of the measuring devices are outlined in details at the Operation Manuals supplied with each device. The producers are also obliged in accordance with the international practice and the Bulgarian legislation to perform supervision control in the process of installation, so and to commissioning in operation of the measurement devices.

The calibration of the separate measurement devices, the procedures in case of measurement device damage or data incorrectness are detail outlined in the Measurement journals of the measurement devices.
The electrical meters are owned by the buyer (Electrical Distribution Company Chez), the main NG flow meters are owned by Bulgargas or Gas Distribution Companies (Citigas Bulgaria). All these companies have implemented the quality system ISO 9001 describing all procedures for the QC/QA.

Question/Issue	Action to be taken
Is data recorded within the usual measurement range?	
Have there been any equipment malfunctions?	
Equipment calibration	
Has data been backed up electronically and on paper?	
Data completeness	

Table 3.4. Data quality checklist

QA/QC procedures are developed in each Journal of Measurement Device that are included in Annex 3 – Measurement journals of the plants.

4. Measurement data 2008 – October 2012 collection

The measurement data are collected from the measurement devices outlined above in accordance with the Monitoring plan, monthly for the period from 01.01.2008 to 31 October of 2012. 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:

Measurement data 01.September 2009- 31.October 2012 collection at Kostenets HHI

Natural gas supply from Bulgargas - ET01 ; [x 1000 Nm3]

Month	2006	2007	2008	2009	<Aug-2010	>Sep-2010	<Aug-2011	>Sep-2011	31.10.2012
Jan	0	0	0	0	696		2		803
Feb	0	0	0	0	561		151		994
Mar	0	0	0	0	388		815		793
Apr	0	0	0	0	0		701		1128
May	0	0	0	0	0		758		951
Jun	0	0	0	0	399		732		810
Jul	0	0	0	0	775		773		713
Aug	0	0	0	0	211		555		753
Sep	0	0	0	474		718		605	1170
Oct	0	0	0	679		681		939	1098
Nov	0	0	0	590		0		1112	0
Dec	0	0	0	664		615		868	0
Total	0	0	0	2,407	3,030	2,014	4,487	3,524	9,212

Natural gas for Tissue machine- ET05 ; [x 1000 Nm3]

Month	2006	2007	2008	2009	<Aug-2010	>Sep-2010	<Aug-2011	>Sep-2011	31.10.2012
Jan	0	0	0	0	0		0		129
Feb	0	0	0	0	0		0		137
Mar	0	0	0	0	0		0		116
Apr	0	0	0	0	0		28		203
May	0	0	0	0	0		48		249
Jun	0	0	0	0	0		69		225
Jul	0	0	0	0	0		91		236
Aug	0	0	0	0	0		143		226
Sep	0	0	0	0		0		107	238
Oct	0	0	0	0		0		180	0
Nov	0	0	0	0		0		162	0
Dec	0	0	0	0		0		137	0
Total	0	0	0	0	0	0	379	586	1,759

Natural gas for CHP and Additional burners ; [x 1000 Nm3]

Month	2006	2007	2008	2009	<Aug-2010	>Sep-2010	<Aug-2011	>Sep-2011	31.10.2012
Jan	0	0	0	0	696	0	2		674
Feb	0	0	0	0	561	0	151		857
Mar	0	0	0	0	388	0	815		677
Apr	0	0	0	0	0	0	673		925
May	0	0	0	0	0	0	710		702
Jun	0	0	0	0	399	0	663		585
Jul	0	0	0	0	775	0	682		477
Aug	0	0	0	0	211	0	412		527
Sep	0	0	0	474	0	718		498	932
Oct	0	0	0	679	0	681		759	1,098
Nov	0	0	0	590	0	0		950	0
Dec	0	0	0	664	0	615		731	0
Total	0	0	0	2,407	3,030	2,014	4,108	2,938	7,453

HFO /mazut/ for Backup Boilers (BB) ; [tons]

Month	2006	2007	2008	2009	<Aug-2010	>Sep-2010	<Aug-2011	>Sep-2011	31.10.2012
Jan	0.0	0.0	0.0	0.0	0.0		0.0		0.0
Feb	0.0	0.0	0.0	0.0	0.0		0.0		0.0
Mar	0.0	0.0	0.0	0.0	0.0		0.0		0.0
Apr	0.0	0.0	0.0	0.0	0.0		0.0		0.0
May	0.0	0.0	0.0	0.0	0.0		0.0		0.0
Jun	0.0	0.0	0.0	0.0	0.0		0.0		0.0
Jul	0.0	0.0	0.0	0.0	0.0		0.0		0.0
Aug	0.0	0.0	0.0	0.0	0.0		0.0		0.0
Sep	0.0	0.0	0.0	**51.9**		0.0		0.0	0.0
Oct	0.0	0.0	0.0	0.0		0.0		0.0	0.0
Nov	0.0	0.0	0.0	0.0		0.0		0.0	0.0
Dec	0.0	0.0	0.0	0.0		0.0		0.0	0.0
Total	0.0	0.0	0.0	51.9	0.0	0.0	0.0	0.0	0.0

Production of steam from CHP and Back up Boiler-ET04 ; [MWht]

Month	2006	2007	2008	2009	<Aug-2010	>Sep-2010	<Aug-2011	>Sep-2011	31.10.2012
Jan	0	0	0	0	3,609		0		3,019
Feb	0	0	0	0	2,860		610		4,200
Mar	0	0	0	0	1,830		3,925		2,965
Apr	0	0	0	0	0		3,136		4,624
May	0	0	0	0	0		3,107		3,263
Jun	0	0	0	0	2,113		2,817		2,794
Jul	0	0	0	0	4,257		3,217		2,040
Aug	0	0	0	0	1,241		1,548		2,397
Sep	0	0	0	2,323		3,803		2,110	4,964
Oct	0	0	0	3,152		3,388		3,443	4,170
Nov	0	0	0	3,176		0		4,639	0
Dec	0	0	0	3,249		3,031		3,645	0
Total	0	0	0	11,900	15,910	10,222	18,359	13,837	34,438

Remark ***For a period from 09.2010 to 10.2012 is executed correction with the positive eror of ET04 measurement system from 0.23 %.***

Generated electricity CHP1 - ET02; [MWhe]

Month	2006	2007	2008	2009	<Aug-2010	>Sep-2010	<Aug-2011	>Sep-2011	31.10.2012
Jan	0	0	0	0	1,191		0		1,496
Feb	0	0	0	0	836		194		1,817
Mar	0	0	0	0	762		639		1,286
Apr	0	0	0	0	0		1,418		1,729
May	0	0	0	0	0		1,340		1,380
Jun	0	0	0	0	874		1,189		1,077
Jul	0	0	0	0	1,511		1,312		562
Aug	0	0	0	0	464		481		796
Sep	0	0	0	764		1,205		784	2,260
Oct	0	0	0	995		1,598		1,418	1,888
Nov	0	0	0	1,157		0		2,215	0
Dec	0	0	0	1,160		1,246		1,716	0
Total	**0**	**0**	**0**	**4,076**	**5,638**	**4,049**	**6,573**	**6,133**	**14,291**

Generated electricity CHP2 - ET03; [MWhe]

Month	2006	2007	2008	2009	<Aug-2010	>Sep-2010	<Aug-2011	>Sep-2011	31.10.2012
Jan	0	0	0	0	0		0		0
Feb	0	0	0	0	112		0		0
Mar	0	0	0	0	27		1,016		0
Apr	0	0	0	0	0		43		265
May	0	0	0	0	0		95		0
Jun	0	0	0	0	0		0		0
Jul	0	0	0	0	185		0		0
Aug	0	0	0	0	0		0		0
Sep	0	0	0	225		440		0	0
Oct	0	0	0	376		0		189	0
Nov	0	0	0	0		0		0	0
Dec	0	0	0	0		0		0	0
Total	**0**	**0**	**0**	**601**	**324**	**440**	**1,154**	**189**	**265**

Generated electricity CHP; [MWhe]

Month	2006	2007	2008	2009	<Aug-2010	>Sep-2010	<Aug-2011	>Sep-2011	31.10.2012
Jan	0	0	0	0	**1,191**		0		1,496
Feb	0	0	0	0	**948**		194		1,817
Mar	0	0	0	0	**789**		1,655		1,286
Apr	0	0	0	0	**0**		1,461		1,994
May	0	0	0	0	**0**		1,435		1,380
Jun	0	0	0	0	**874**		1,189		1,077
Jul	0	0	0	0	**1,696**		1,312		562
Aug	0	0	0	0	**464**		481		796
Sep	0	0	0	**989**		1,645		784	2,260
Oct	0	0	0	**1,371**		1,598		1,607	1,888
Nov	0	0	0	**1,157**		0		2,215	0
Dec	0	0	0	**1,160**		1,246		1,716	0
Total	**0**	**0**	**0**	**4,677**	**5,962**	**4,489**	**7,727**	**6,322**	**14,556**

CHP generated electricity exported to NEC grid- ET06 + ET07; [MWhe]

Month	2006	2007	2008	2009	<Aug-2010	>Sep-2010	<Aug-2011	>Sep-2011	31.10.2012
Jan	0	0	0	0	0		0		0
Feb	0	0	0	0	0		0		0
Mar	0	0	0	0	0		0		0
Apr	0	0	0	0	0		0		0
May	0	0	0	0	0		0		0
Jun	0	0	0	0	0		0		0
Jul	0	0	0	0	0		0		0
Aug	0	0	0	0	0		0		0
Sep	0	0	0	0		0		0	0
Oct	0	0	0	0		0		0	0
Nov	0	0	0	0		0		0	0
Dec	0	0	0	0		0		0	0
Total	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

LHV_{NG} - Lower heat value of NG. Values are from Bulgargas certificates [kcal/Nm³]

Month	2006	2007	2008	2009	<Aug-2010	>Sep-2010	<Aug-2011	>Sep-2011	31.10.2012
Jan	0	0	8,020	8,029	8,042		8,007		8,042
Feb	0	0	8,013	8,047	8,049		8,010		8,043
Mar	0	0	8,021	8,064	8,051		7,978		8,028
Apr	0	0	8,021	8,083	8,090		8,014		8,044
May	0	0	0	8,090	8,065		8,027		8,059
Jun	0	0	0	8,089	8,095		8,012		8,074
Jul	0	0	0	8,083	8,089		8,033		8,050
Aug	0	0	0	8,071	8,096		8,047		8,039
Sep	0	0	8,031	8,061		8,084		8,084	8,043
Oct	0	0	8,031	8,049		8,059		8,059	8,052
Nov	0	0	8,027	8,037		8,012		8,012	
Dec	0	0	8,055	8,055		8,007		8,007	
Average	**0**	**0**	**8,027**	**8,063**	**8,072**	**8,041**	**8,016**	**8,041**	**8,047**

Natural gas for CHP and BB consumption ; [GJ]

Month	2006	2007	2008	2009	<Aug-2010	>Sep-2010	<Aug-2011	>Sep-2011	31.10.2012
Jan	0	0	0	0	23,432		55		22,683
Feb	0	0	0	0	18,897		5,059		28,868
Mar	0	0	0	0	13,074		27,228		22,739
Apr	0	0	0	0	0		22,585		31,167
May	0	0	0	0	0		23,853		23,674
Jun	0	0	0	0	13,530		22,249		19,790
Jul	0	0	0	0	26,255		22,953		16,076
Aug	0	0	0	0	7,136		13,879		17,739
Sep	0	0	0	15,983		24,298		16,850	31,372
Oct	0	0	0	22,896		22,981		25,613	37,003
Nov	0	0	0	19,841		0		31,870	0
Dec	0	0	0	22,392		20,617		24,491	0
Total	**0**	**0**	**0**	**81,112**	**102,324**	**67,896**	**137,861**	**98,824**	**251,111**

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 2.3 above.

Baseline emissions calculation Kostenets HHI

LHVNG - Lower heating walue in kKal/Nm3 For natural gas in Bulgaria. Value provided by Bulgargas Certificates (see sheet "annual consuption" for details).
EFNG - CO2 emissions factor (combustion) 56.1 kg/GJ Natural gas (dry): 15.3 t C/TJ lower heating value basis x 44/12 = 56.1 t CO2/TJ IPCC 2006
EFHFO - CO2 emissions factor (combustion) 77.4 kg/GJ HFO /mazut/ IPCC 2006

CHP 2 x Centrax 501 KB5 Heat production

Year	Year	**h** production BB	Steam production for CHP and BB	Replaced heat from CHP and BB	CO2 emissions (combustion)
			MWh/year	GJ/year	t/year
1	2006	0.89	0	0	0.0
2	2007	0.89	0	0	0.0
3	2008	0.89	0	0	0.0
4	2009	**0.89**	**11,900**	**42,840**	**3,725.6**
5	Jan-Aug.2010	**0.89**	**15,910**	**57,275**	**4,981.0**
6	**Sep-Dec.2010**	**0.89**	**10,222**	**36,801**	**3,200.4**
7	**Jan-Aug.2011**	**0.89**	**18,359**	**66,091**	**5,443.2**
8	**Sep-Dec.2011**	**0.89**	**13,837**	**49,814**	**4,102.6**
9	**Jan-Oct.2012**	**0.89**	**34,438**	**123,975**	**10,210.6**

EFELgen. CO2 emissions factor - generating electricity gCO2/kWh
Netherland Guidness B4 or ex-post official Bulgarian EF.
B**EFELcons**. CO2 emissions factor - consumption electricity gCO2/kWh
Netherland Guidness B4 or ex-post official Bulgarian EF.

CHP 2 x Centrax 501 KB5 - Electricity production

Year	Year	Electricity production of CHP export (Replaced generation of NEC grid)	Electricity production of CHP for consumption of factory replacing	**BEFELcons.** replaced consumption of factory	CO2 baseline emissions
		MWh/year	MWh/year	t/MWh	t/year
1	2006	0	0	0.000	0.0
2	2007	0	0	0.000	0.0
3	2008	0	0	0.000	0.0
4	2009	**0**	4,677	0.867	4,055.0
5	Jan-Aug.2010	**0**	5,962	0.845	5,037.9
6	**Sep-Dec.2010**	**0**	**4,489**	**0.845**	**3,793.2**
7	**Jan-Aug.2011**	**0**	**7,727**	**0.822**	**6,351.6**
8	**Sep-Dec.2011**	**0**	**6,322**	**0.822**	**5,196.7**
9	**Jan-Oct.2012**	**0**	**14,556**	**0.800**	**11,644.8**

5.2 Project emissions calculation

The calculations are based on formulas in point 2.4 .

Project emissions calculation for Kostenets HHI

LHV_{NG} - Lower heating walue in kKal/Nm3 For natural gas in Bulgaria. Value provided by Bulgargas Certificates (see sheet "annual consuption" for details).
LHV_{HFO} - Lower heating value 39.805 GJ/t For HFO /mazut/ in Bulgaria. Value provided by BDS
EF_{NG} - CO2 emissions factor (combustion) 56.1 kg/GJ Natural gas (dry): 15.3 t C/TJ lower heating value basis x 44/12 = 56.1 t CO2/TJ IPCC 2006
EF_{HFO} - CO2 emissions factor (combustion) 77.4 kg/GJ HFO /mazut/ IPCC 2006

CHP 2 x Centrax 501 KB5

Year	Year	**HFO** consumption (combustion) in BB	Natural gas consumption (combustion) in CHP, BB and additional burners	Electricity Production of CHP Electricity generation to NEC grid	EFel.gen emission factor generation to NEC grid	CO2 Emissions (combustion)	CO2 Emissions generation to NEC grid	**CO2 Project emissions**
		GJ/year	GJ/year	MWh/year		t/year	t/year	t/year
1	2006	0	0	0	0.000	0	0	0
2	2007	0	0	0	0.000	0	0	0
3	2008	0	0	0	0.000	0	0	0
4	**2009**	**2,065**	**81,112**	**0**	**0.000**	**4,710**	**0**	**4,710**
5	**Jan-Aug.2010**	**0**	**102,324**	**0**	**0.000**	**5,740**	**0**	**5,740**
6	**Sep-Dec.2010**	**0**	**67,896**	**0**	**0.000**	**3,809**	**0**	**3,809**
7	**Jan-Aug.2011**	**0**	**137,861**	**0**	**0.000**	**7,734**	**0**	**7,734**
8	**Sep-Dec.2011**	**0**	**98,824**	**0**	**0.000**	**5,544**	**0**	**5,544**
9	**Jan-Oct.2012**	**0**	**251,111**	**0**	**0.000**	**14,087**	**0**	**14,087**

5.3 Emissions reduction calculations

The calculations are based on the formula in point 2.5.

Emissions reduction calculations - Kostenets HHI

		Base Line		**Project Line**	**Reduction**		
Year	Year	CO2equiv. Emissions Heat	CO2 Emissions Electricity	CO2equiv. Emissions CHP and BB	CO2equiv.		
		t/year	t/year	t/year	t/year		
1	2006	0	0	0	0		
2	2007	0	0	0	0		
3	2008	0	0	0	0		
4	2009	3,726	4,055	4,710	3,070	**7,349**	
5	Jan-Aug.2010	4,981	5,038	5,740	4,278		
6	**Sep-Dec.2010**	**3,200**	**3,793**	**3,809**	**3,185**	**7,246**	**18,769**
7	**Jan-Aug.2011**	**5,443**	**6,352**	**7,734**	**4,061**		
8	**Sep-Dec.2011**	**4,103**	**5,197**	**5,544**	**3,755**	**11,523**	
9	**Jan-Oct.2012**	**10,211**	**11,645**	**14,087**	**7,768**		
Total for the period		**31,663**	**36,079**	**41,625**	**26,118**		

The calculations files are attached in Annex No.1 to the Monitoring Report.

6. Measurement Data Crosscheck

KOSTENETS HHI CoGen Power Plant
Когенерация КОСТЕНЕЦ ХХИ

DATA LOG 2009
Crosscheck of consumption data with corresponding supplier/buyer invoices
ЖУРНАЛ 2009
Сравнение на данните от консумацията със съответните данни по фактури

Natural gas for CHP and BB ; [x 1000 Nm3]
Природна газ за когенерация и котли; [x 1000 Nm3]

Month	measured value	document value	document - type/Nr.	Supplier
Месец	измерена ст-ст	ст-ст по документ	документ - тип/номер	Доставчик
Jan	0.000	0.000	-	-
Feb	0.000	0.000	-	-
Mar	0.000	0.000	-	-
Apr	0.000	0.000	-	-
May	0.000	0.000	-	-
Jun	0.000	0.000	-	-
Jul	0.000	0.000	-	-
Aug	0.000	0.000	-	-
Sep	473.568	473.568	**inv. 125330 / 125855**	**Bulgargas**
Oct	679.419	679.419	**inv. 126098 / 126341 / 126650**	**Bulgargas**
Nov	589.629	589.629	**inv. 126900 / 127478**	**Bulgargas**
Dec	663.956	663.956	**inv. 127727 / 128301**	**Bulgargas**
Total	**2,406.572**	**2,406.572**		
Difference/Разлика		**0.000**		

CHP generated electricity exported to NEC grid; [MWhe]
Електроенергия, доставена към мрежата на НЕК; [MWhe]

Month	measured value	document value	document - type/Nr.	Buyer
Месец	измерена ст-ст	ст-ст по документ	документ - тип/номер	Доставчик
Jan	0.0	0.0	-	-
Feb	0.0	0.0	-	-
Mar	0.0	0.0	-	-
Apr	0.0	0.0	-	-
May	0.0	0.0	-	-
Jun	0.0	0.0	-	-
Jul	0.0	0.0	-	-
Aug	0.0	0.0	-	-
Sep	0.0	0.0	-	-
Oct	0.0	0.0	-	-
Nov	0.0	0.0	-	-
Dec	0.0	0.0	-	-
Total	**0.0**	**0.0**		
Difference/Разлика		**0.000**		

HFO /mazut/ for Backup Boilers (BB) ; [tons]
Количество мазут за котлите; [тона]

Month	measured value	document value	document - type/Nr.	Supplier
Месец	измерена ст-ст	ст-ст по документ	документ - тип/номер	Доставчик
Jan	0	0	-	-
Feb	0	0	-	-
Mar	0	0	-	-
Apr	0	0	-	-
May	0	0	-	-
Jun	0	0	-	-
Jul	0	0	-	-
Aug	0	0	-	-
Sep	51.58	51.58	-	-
Oct	0	0	-	-
Nov	0	0	-	-
Dec	0	0	-	-
Total	**51.58**	**51.58**		
Difference/Разлика		**0.000**		

KOSTENETS HHI CoGen Power Plant
Когенерация КОСТЕНЕЦ ХХИ

DATA LOG 2010

Crosscheck of consumption data with corresponding supplier/buyer invoices

ЖУРНАЛ 2010

Сравнение на данните от консумацията със съответните данни по фактури

Natural gas for CHP and BB ; [x 1000 Nm3]
Природна газ за когенерация и котли; [x 1000 Nm3]

Month	measured value	document value	document - type/Nr.	Supplier
Месец	измерена ст-ст	ст-ст по документ	документ - тип/номер	Доставчик
Jan	695.935	695.935	inv. 128547 / 128795 / 129072	Bulgargas
Feb	560.763	560.763	inv. 129316 / 129857	Bulgargas
Mar	387.858	387.858	inv. 130348 / 130622	Bulgargas
Apr	0.000	0.000	-	-
May	0.000	0.000	-	-
Jun	399.218	399.218	inv. 132344 / 132822	Bulgargas
Jul	775.237	775.237	inv. 133044 / 133515	Bulgargas
Aug	210.538	210.538	inv. 133738 / 134212	Bulgargas
Sep	717.902	708.000	inv. 134438 / 134923	Bulgargas
Oct	681.087	691.000	inv. 135163 / 135688	Bulgargas
Nov	0.000	0.000	-	-
Dec	615.009	615.000	inv. 136755 / 137296	Bulgargas
Total	5,043.547	5,043.549		
Difference/Разлика		-0.002		

CHP generated electricity exported to NEC grid; [MWhe]
Електроенергия, доставена към мрежата на НЕК; [MWhe]

Month	measured value	document value	document - type/Nr.	Buyer
Месец	измерена ст-ст	ст-ст по документ	документ - тип/номер	Доставчик
Jan	0.0	0.0	-	-
Feb	0.0	0.0	-	-
Mar	0.0	0.0	-	-
Apr	0.0	0.0	-	-
May	0.0	0.0	-	-
Jun	0.0	0.0	-	-
Jul	0.0	0.0	-	-
Aug	0.0	0.0	-	-
Sep	0.0	0.0	-	-
Oct	0.0	0.0	-	-
Nov	0.0	0.0	-	-
Dec	0.0	0.0	-	-
Total	0.0	0.0		
Difference/Разлика		0.000		

HFO /mazut/ for Backup Boilers (BB) ; [tons]
Количество мазут за котлите; [тона]

Month	measured value	document value	document - type/Nr.	Supplier
Месец	измерена ст-ст	ст-ст по документ	документ - тип/номер	Доставчик
Jan	0	0	-	-
Feb	0	0	-	-
Mar	0	0	-	-
Apr	0	0	-	-
May	0	0	-	-
Jun	0	0	-	-
Jul	0	0	-	-
Aug	0	0	-	-
Sep	0	0	-	-
Oct	0	0	-	-
Nov	0	0	-	-
Dec	0	0	-	-
Total	0	0		
Difference/Разлика		0.000		

KOSTENETS HHI CoGen Power Plant
Когенерация КОСТЕНЕЦ ХХИ

DATA LOG 2011
Crosscheck of consumption data with corresponding supplier/buyer invoices
ЖУРНАЛ 2011
Сравнение на данните от консумацията със съответните данни по фактури

Natural gas for CHP and BB ; [x 1000 Nm3]
Природна газ за когенерация и котли; [x 1000 Nm3]

Month	measured value	document value	document - type/Nr.	Supplier
Месец	измерена ст-ст	ст-ст по документ	документ - тип/номер	Доставчик
Jan	1.626	2.000	inv. 137539 / 138051	Bulgargas
Feb	150.840	151.000	inv. 138293 / 138801	Bulgargas
Mar	815.145	815.000	inv. 139039 / 139277 / 139542	Bulgargas
Apr	701.126	701.000	inv. 139774 / 140006 / 140261	Bulgargas
May	757.761	758.000	inv. 140486 / 140714 / 140968	Bulgargas
Jun	732.255	732.000	inv. 141189 / 141411 / 141661	Bulgargas
Jul	773.473	773.000	inv. 141880 / 142099 / 142343	Bulgargas
Aug	554.956	555.000	inv. 142566 / 142788 / 143042	Bulgargas
Sep	604.840	605.000	inv. 143270 / 143496 / 143754	Bulgargas
Oct	939.096	939.000	inv. 143990 / 144226 / 144510	Bulgargas
Nov	1,112.064	1,112.000	inv. 144750 / 144990 / 145129	Bulgargas
Dec	867.571	868.000	inv. 145513 / 145754 / 146043	Bulgargas
Total	8,010.753	8,011.000		
Difference/Разлика		-0.247		

CHP generated electricity exported to NEC grid; [MWhe]
Електроенергия, доставена към мрежата на НЕК; [MWhe]

Month	measured value	document value	document - type/Nr.	Buyer
Месец	измерена ст-ст	ст-ст по документ	документ - тип/номер	Доставчик
Jan	0.0	0.0	-	-
Feb	0.0	0.0	-	-
Mar	0.0	0.0	-	-
Apr	0.0	0.0	-	-
May	0.0	0.0	-	-
Jun	0.0	0.0	-	-
Jul	0.0	0.0	-	-
Aug	0.0	0.0	-	-
Sep	0.0	0.0	-	-
Oct	0.0	0.0	-	-
Nov	0.0	0.0	-	-
Dec	0.0	0.0	-	-
Total	0.0	0.0		
Difference/Разлика		0.000		

HFO /mazut/ for Backup Boilers (BB) ; [tons]
Количество мазут за котлите; [тона]

Month	measured value	document value	document - type/Nr.	Supplier
Месец	измерена ст-ст	ст-ст по документ	документ - тип/номер	Доставчик
Jan	0	0	-	-
Feb	0	0	-	-
Mar	0	0	-	-
Apr	0	0	-	-
May	0	0	-	-
Jun	0	0	-	-
Jul	0	0	-	-
Aug	0	0	-	-
Sep	0	0	-	-
Oct	0	0	-	-
Nov	0	0	-	-
Dec	0	0	-	-
Total	0	0		
Difference/Разлика		0.000		

KOSTENETS HHI CoGen Power Plant
Когенерация КОСТЕНЕЦ ХХИ

DATA LOG 2012

Crosscheck of consumption data with corresponding supplier/buyer invoices

ЖУРНАЛ 2012

Сравнение на данните от консумацията със съответните данни по фактури

Natural gas for CHP and BB ; [x 1000 Nm3]
Природна газ за когенерация и котли; [x 1000 Nm3]

Month	measured value	document value	document - type/Nr.	Supplier
Месец	измерена ст-ст	ст-ст по документ	документ - тип/номер	Доставчик
Jan	802.681	803.000	**inv. 146276 / 146508 / 146764**	**Bulgargas**
Feb	994.267	994.000	**inv. 146993 / 147226 / 147385**	**Bulgargas**
Mar	792.524	793.000	**inv. 147712 / 147942 / 148202**	**Bulgargas**
Apr	1,128.430	1,128.000	**inv. 148425 / 148649 / 148742**	**Bulgargas**
May	950.645	951.000	**inv. 149120 / 149341 / 149595**	**Bulgargas**
Jun	810.439	810.000	**inv. 149807 / 150021 / 150285**	**Bulgargas**
Jul	712.980	713.000	**inv. 150497 / 150711 / 150987**	**Bulgargas**
Aug	753.041	753.000	**inv. 151201 / 151415 / 151702**	**Bulgargas**
Sep	1,169.621	1,170.000	**inv. 151914 / 152129 / 152253**	**Bulgargas**
Oct	1,097.609	1,098.000	**inv. 152640 / 152866 / 152982**	**Bulgargas**
Nov	0.000	0.000	-	-
Dec	0.000	0.000	-	-
Total	**9,212.237**	**9,213.000**		
Difference/Разлика		**-0.763**		

CHP generated electricity exported to NEC grid; [MWhe]
Електроенергия, доставена към мрежата на НЕК; [MWhe]

Month	measured value	document value	document - type/Nr.	Buyer
Месец	измерена ст-ст	ст-ст по документ	документ - тип/номер	Доставчик
Jan	0.0	0.0	-	-
Feb	0.0	0.0	-	-
Mar	0.0	0.0	-	-
Apr	0.0	0.0	-	-
May	0.0	0.0	-	-
Jun	0.0	0.0	-	-
Jul	0.0	0.0	-	-
Aug	0.0	0.0	-	-
Sep	0.0	0.0	-	-
Oct	0.0	0.0	-	-
Nov	0.0	0.0	-	-
Dec	0.0	0.0	-	-
Total	**0.0**	**0.0**		
Difference/Разлика		**0.000**		

HFO /mazut/ for Backup Boilers (BB) ; [tons]
Количество мазут за котлите; [тона]

Month	measured value	document value	document - type/Nr.	Supplier
Месец	измерена ст-ст	ст-ст по документ	документ - тип/номер	Доставчик
Jan	0	0	-	-
Feb	0	0	-	-
Mar	0	0	-	-
Apr	0	0	-	-
May	0	0	-	-
Jun	0	0	-	-
Jul	0	0	-	-
Aug	0	0	-	-
Sep	0	0	-	-
Oct	0	0	-	-
Nov	0	0	-	-
Dec	0	0	-	-
Total	**0**	**0**		
Difference/Разлика		**0.000**		