MONITORING REPORT

2008

JI PROJECT

COGENERATION GAS POWER PORTFOLIO
AKB FORES PLC Financial Industrial Group

Polimeri JSC
Kostenets HHI JSC
Toplofikatsia Kazanlak JSC

Sofia, April 2009

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 that by electricity supplied by CHP	tCO_2/y
BEth	baseline CO_2 emissions that would be 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 natural gas	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 with the JI - Project Design Document and provides the measurements and calculations of the GHG emissions reduction in result of co –generation installations operation during 2008.

1.1 Project participants

GHG reductions supplier:
AKB Fores PLC.
Financial & Industrial Concern
20, F.J.Curie Str.
1113 Sofia, Bulgaria
Website: www.akbfores.com
No. of Employees: approximately 6,000
Registration number:11130
Date of registration: 18.09.2001
Bank account number:1401825419
Bank name: Tsentralna Kooperativna Banka
Bank code: 22092207

Corresponder's data
Global Carbon BV
Visiting address, zip code + city, country:
Niasstraat 1 3531 WR • Utrecht, The Netherlands
Contact person: Erik Saat, Director
Telephone number: +31 30 8506724
Fax number: +31 70 8910791
E-mail: saat@global-carbon.com
Website: www.global-carbon.com

Project partners
Polimeri JSC, 9600 Devnia, Industrial Zone, Bulgaria
No. of Employees: 492
Registration number: 447
Date of registration: 1993
Bank account number: 12000103517
Bank name: Tsentralna Kooperativna Banka
Bank code: 79078081
Company's core business: Polimeri JSC is the only one producer in Bulgaria of ethane dichloride, sodium hydroxide-liquid, hydrochloric acid, liquid chloride and ferrichloride. Polimeri JSC

produces also technical salt, bleaching solution, liquid nitrogen, liquid oxygen, refined brine, PVC for pipes and fittings.

Kostenets – HHI JSC, 2, Saedinenie Str., 2030 Kostenets, Bulgaria
Wesbsite: www.hhi-bg.com
No. of Employees: 362
Registration number: 4492
Date of registration: 1991
Bank account number: 1004792607
Bank name: Bulbank JSC
Bank code: 62196214
Company's core business: Kostenets JSC is producer of paper and products from paper like toilet paper, corrugated-board paper etc.

Toplofikatsia Kazanlak JSC, 42, Tsar Osvoboditel Str., 6100 Kazanlak, Bulgaria
Website: www.heatkz.bg
No. of Employees: 141
Registration number: 3300
Date of registration: 1995
Bank account number: 1074988946
Bank name: Bulbank Kazanlak
Bank code: 62176307
Company's core business: Toplofikatsia Kazanlak JSC is producer of energy in the form of heat water and steam for the town and electricity for the National Electrical Company (NEK).

1.2 Project locations

The 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 showed on the map below and are executed in the following plants:

Polimeri JSC is located in valley of Devnia at town Devnia 30 km to town Varna, see location on the picture below. The valley of Devnia is called in Bulgaria "The valley of the big chemistry". Here are situated big plants like Solvay Sodi JSC, Agropolychim JSC, Devnia Cement JSC, Besin JSC, PS Deven JSC. The cogeneration site is situated close to the main Electrical substation of the factory and to the main consumers of the steam.

The attitude of Devnia is 12 m above of the sea level that is especially friendly to the gas turbines. The average temperature is 14.6 º C.

Kostenets HHI JSC is located in town Kostenets about 70 km from Sofia in south direction. The settlement into the present 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.

Toplofikatsia Kazanlak JSC- is located in town Kazanlak. Kazanlak is administrative centre of the municipality in the pretty Valley of Roses. The town is situated at the foot of the Balkan Mountains. The natural geographical centre of Bulgaria is just here. Kazanlak is important industrial centre, here are Arsenal JSC, Hydravlika Kazanlak, Boncho Shanov and others. The attitude of Kazanlak is 350 m above sea level and the average temperature between – 0,5 º C to + 21.8 º C. The population is around 71 000 inhabitants of which 58 % in employable age.

Toplofikatsia Kazanlak JSC is district heating thermal station for combined production of heat water, steam and electricity. Two cogeneration modules with gas engines are realized in the project. The cogenerations modules site is closed to the boiler installation and to the electrical substation. The hot water pipes and the cables connections are with short length.

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 CO_2 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 Industrial factories in Polimeri JSC and Kostenets HHI

The Polimeri JSC factory bought the thermal energy from neighbouring coal fired Thermal Power Station Devnia and it buys electricity from the NEK to the CHP realization. With the investment in a new CHP, Polimeri produces the majority of its own requirements for heat and electricity.

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.

District heating project activities in Toplofikatsia Kazanlak

The district heating power plant of Toplofikatsia Kazanlak used heavy fuel oil (HFO) to generate heat for the town of Kazanlak and to produce electricity mainly for the national grid. The costs for this fuel are relatively high compared to the costs of using natural gas. In example, the price of HFO for equal caloric values is to 2 times higher than of natural gas.

Beside the installation of two cogeneration modules, Toplofikatsia Kazanlak additionally changed the burners of three existing boilers, which produce the necessary steam and hot water to the meet the needs over the production of the two gas engines.

At the same time, the district heating power plants will increase their efficiencies and reduce emissions thanks to the cogeneration modules. They will reduce emissions even further through the replacement of the burners . The National Electricity Company (NEC) is obligated to purchase the generated electricity from the cogeneration systems against a preferential tariff (Energy law, article 162). The electricity price approved for 2008 from SWERC is 98 EUR/MWhe .

The issues with reference to the construction of own cogeneration modules and the gasification of the boilers within Toplofikatsia Kazanlak, are:

- The production price for thermal energy will become more competitive leading enabling Toplofikatsia Kazanlak to increase the number of their customers.
- The power plant will better be able to serve their customers through increased flexibility and security of their generation capacity.
- The environmental conditions in the town Kazanlak will be improved with the realizing of the project.

The realized highly efficient CHP plants will resolve the following issues for the factories of Polimeri and Kostenets:

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

- The new cogeneration modules will provide for competitive generation of electricity and steam. This will result in cost reduction for the core business of the factories.
- The new facilities provide for a better flexibility to adapt to the needs of the production process while keeping efficiency at an attractive level.
- The environmental condition at the factories and the regions will be improved;

1.4 Description of the Project activities

A common view of one from the realized co-generation projects is shown on the picture bellow:

Fig.1.4.1 – Cogeneration installation at Kostenets HHI common view

The installations in Polimeri and Kostenets are with gas turbine modules while the cogeneration in Toplofikatsia Kazanlak is with gas engine modules.
The main Cogeneration Gas Power Stations equipment in Polimeri and Kostenets comprise gasturbine 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 Polimeri	Cogen Sets Kostenets
Number of gensets		2	2
Gas Turbine Type		Rolls-Royce Allison 501 KB7 Simple cycle, single shaft	Rolls-Royce Allison 501 KB5 Simple cycle, single shaft
Year of production		2007	2007
Producer		Centrax LTD, England	Centrax LTD, England
Electrical power /installed/	[MWe]	5.44	3.79
Fuel – Natural gas LHV	[kJ/kg]	49252	49252
Fuel consumption	[kJ/KWh]	11854	13208
Exhaust gases temperature	ºC	518	560
Exhaust gases flow	[kg/s]	20.6	15.6
Turbine axial compressor - stages compression ratio		14 9.175:1.0	14 9.175:1.0
Turbine - stages		4	4
Speed	[rpm]	14571	14571
Weight	[kg]	767	577
NOx control –Water	[kg/s]	0.21	0.16
Generator Type		Synchronous LSA 56 BUL85 4P	Synchronous LSA 56 BUL85 4P
Year of production		2007	2007
Producer		Leroy Somer	Leroy Somer
Rated Voltage	[kV]	6.3	6.3
Rated Frequency	[Hz]	50	50
Rated Power	[MWe]	5.9	5.9
Speed	[rpm]	1500	1500
Power Factor		0.8	0.8

Table 1.4.1- Polimeri and Kostenets gensets main technical data

The genset is 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 Polimeri		HRSGs Kostenets	
Boilers		Boiler 1	Boiler 2	Boiler 1	Boiler 2
Type		HRSG/one pass boiler/		HRSG/one pass boiler/	
Year of production		2007		2007	
Producer		Ambitermo, Portugal		Ambitermo, Portugal	
Exhaust gas flow at 100%MCR/15ºC	[kg/h]	74160		56160	
Exhaust gas temperature inlet	[º C]	504		535	
Condensate	[%]	-		70 at 70 ºC	
Inlet water temper. to economizer 1 and 2	[ºC]	20		20	
Waste Recovery Only at 100% MCR / 15ºC					
Gross steam	[t /h]	10.30	10.45	10.05	10.05
- Temperature	[ºC]	320	320	210	210
- Pressure	[barg]	22	16	18	18
Technological steam	[t /h]	10.16	10.13	9.75	9.75
- Temperature	[ºC]	320	320	210	210
- Pressure	[barg]	22	16	18	18
De-Aerator steam	[t /h]	0.14	0.32	0.3	0.3
Exhaust gas temperature outlet	[º C]	132	130	126	126
Waste Recovery + Post Combustion at 100% MCR / 15ºC					
Burner Heat Input /Natural Gas /	[MWht/h]	9.8	9.78	3.80	3.80
Gross steam	[t /h]	24	24	15.99	15.99
- Temperature	[ºC]	320	320	210	210
- Pressure	[barg]	22	16	18	18
Technological steam	[t /h]	21.5	21.32	15.00	15.00
- Temperature	[ºC]	320	320	210	210
- Pressure	[barg]	22	16	18	18
De-Aerator steam	[t /h]	2.5	2.68	0.99	0.99
Exhaust gas temperature outlet	[º C]	127	125	`122	`122

Table 1.4.2 – Polimeri and Kostenets Heat Recovery Steam Generators main technical data

The project at Toplofikatsia Kazanlak comprise two different type cogeneration gas engine installations. The cogeneration modules produce electricity mainly for export to national network and heat water for heating of town Kazanlak.

Additionally the project in Toplofikatsia Kazanlak includes the gasification of three boilers, one type PKM 12 with capacity of 8 MWt and two KM12 with capacity also 8 MWt., beside the installation of the cogeneration module. The existing oil burners are remade and here additionally are added gas burners. The boilers produce steam and in heat exchanger the steam heated water for heating of the town, also they ensure steam for direct steam consumers.

Principal block scheme of the one cogeneration installation / AE 20V4000L62 / at Toplofikatsia Kazanlak is shown on the figure below:

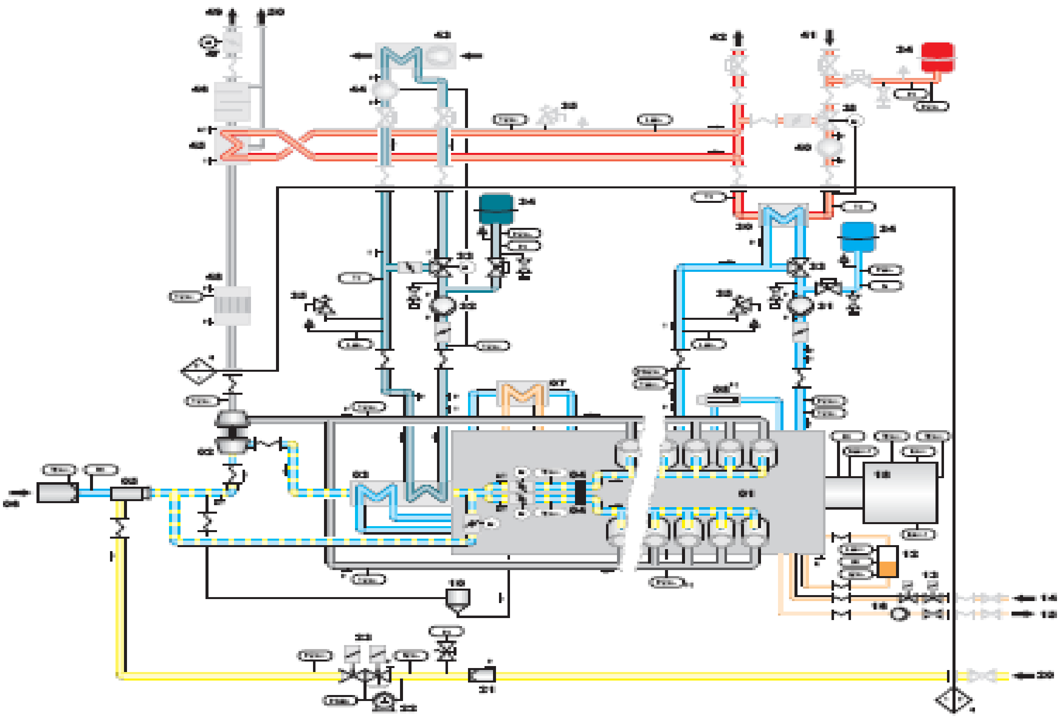


Fig.1.4.2 - Principal block scheme of cogeneration installation AE 20V4000L62

The technical parameters of the gas engine cogenerations in Toplofikatsia Kazanlak can be seen in table No.3 below:

Parameters	Dimens.	Cogen gas engine modul 1	Cogen gas engine modul 2
Number of gensets		1	1
Cogeneration gas engine type		JMS 612 GS- N.L.C.	AE 20V4000L62
Year of production		2007	2008
Producer		GE Jenbacher, Austria	MDE-Dezentrale Energiesysteme, Germany
Electrical power /output/	[MWhe/h]	1.82	1.944
Thermal power /output/	[MWht/h]	1.843	2.32
Fuel – Natural gas LHV	[kJ/kg]	49252	49252
Fuel consumption	[MWht/h]	4.257	4.88
Exhaust gases temperature	ºC	-	466
Exhaust gases flow	[kg/s]	-	2.86
Number of cylinders	-	12	20
Total displacement	[l]	74.9	95.32
Speed	[rpm]	1500	1500
Heating water volume flow	[m^3/h]	78.2	96
Efficiency/ total /	[%]	86.2	87.3
NOx control –Filter	[mg/Nm^3]	< 250	< 250
Generator Type		Synchronous	Synchronous
Rated Voltage	[kV]	6.3	0.4
Rated Frequency	[Hz]	50	50

Table 1.4.3 – Main technical data of cogeneration installations at Toplofikatsia Kazanlak

1.5 Implementation of the project

The project implementation is shown in the table No.4 below:

No	Name of activity	Terms of execution			
	Subproject	Polimeri JSC	Kostenets HHI JSC	Toplofikatsia Kazanlak	
				Cogen. Inst.1	Cogen Inst.2
1	Start of the project	04. 2005	04. 2005	04. 2005	
2	Project detail design	11.2006- 09.2007	11.2006- 09.2007	06.2007- 10.2007	08.2009 – 09.2009
3	Construction on site	10.2007 – 04.2008	01.2008- 07.2008	08.2008- 11.2007	08.2009-09.2009
4	Equipment delivery	12.2006-02.2008	12.2006-03.2008	03.2008 – 10. 2007	08.2009-11.2009
5	Equipment installing	02.2008-06.2008	04.2008-08.2008	10.2007 – 11. 2007	11.2009-11.2009
6	NG supply providing	01.2010	06.2009	May.2007	
7	Operation tests	01.2010-02.2010	07.2009-08.2009	11.2007- 12.2007	12.2009-12.2009
8	Commissioning	02.2010-02.2010	08.2009-08.2009	12. 2007 – 01. 2008	12.2009 – 01.2010
9	Start of operation	01.03.2010	01.09.2009	01.01.2008	15.01.2009

Table 1.5.1 – Implementation of the project

1.6 Expected capacity

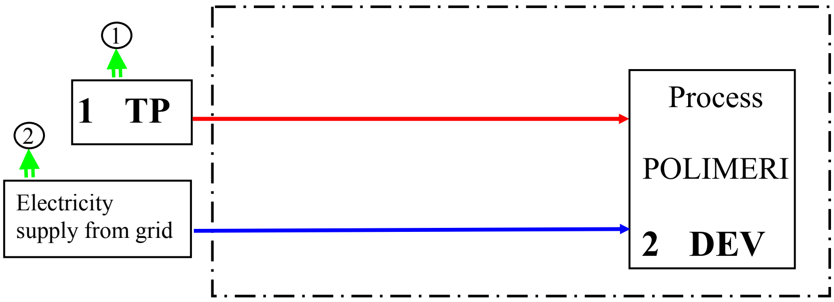
The production capacity of the co-generation stations have been selected mainly on the bases of the steam needs of the factories. The expected annual availability was estimated of 8200 hours per year for Polimeri Station and Kostenets HHI Station. For Toplofikatsia Kazanlak was estimated average of 5000 – 5500 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.

2.1.1 **Flowchart of the situation for Polimeri Devnia**

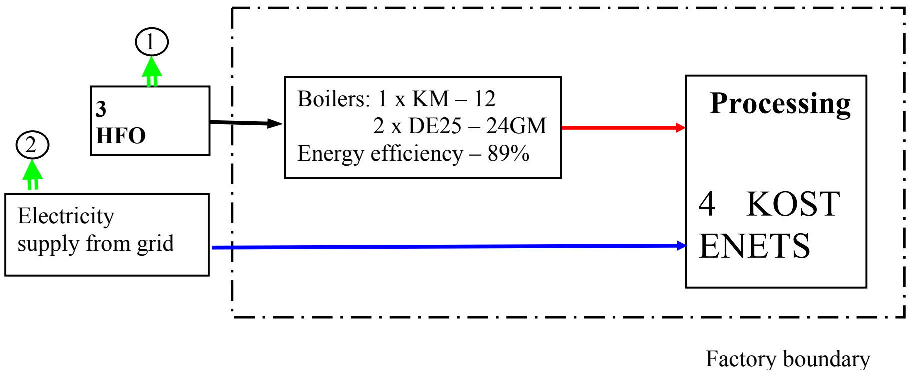


Factory

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

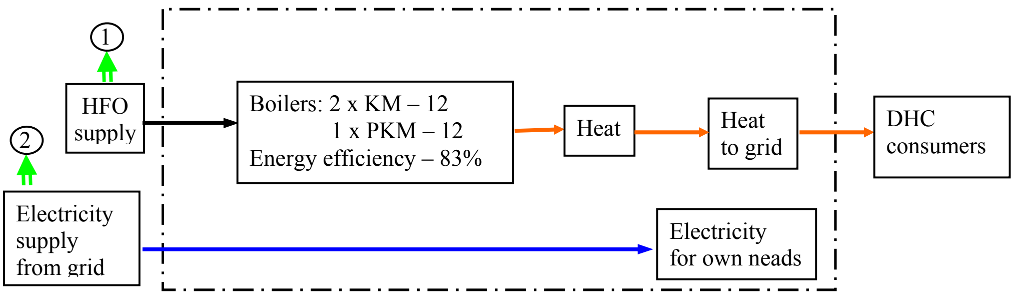
Fig.2.1.1.1 - Flowchart of current delivery system with it's the main components and their connections for Polimeri Devnia.

2.1.2 Flowchart of the situation for Kostenets HHI



1 – CO_2 emissions (combustion in boilers)
2 – CO_2 emissions (electricity from grid)
Fig. 2.1 2 1 -Flowchart of current delivery system with it's the main components and their connections for Kostenets HHI.

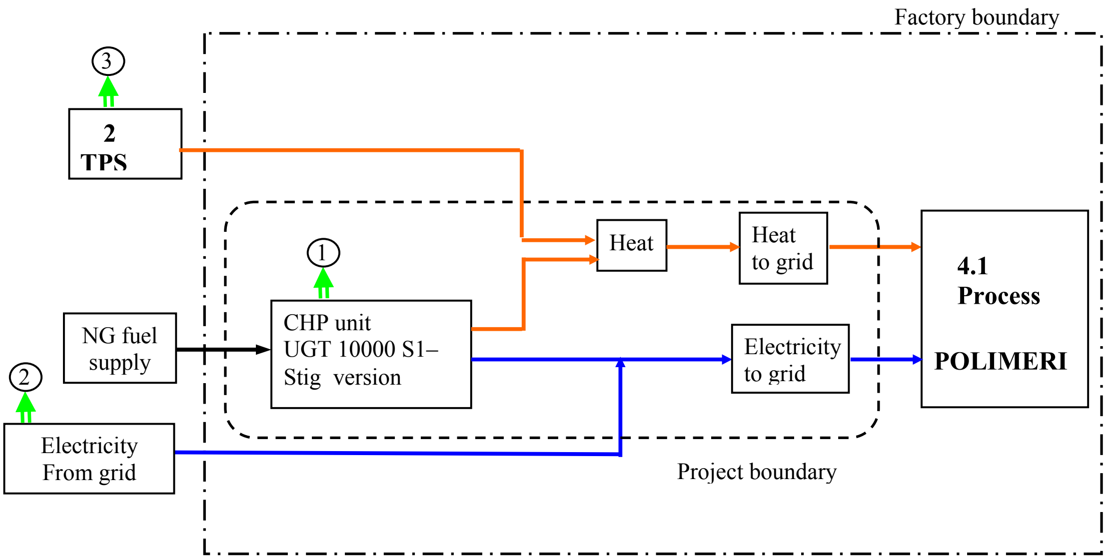
2.1.3 Flowchart of the situation for Toplofikatsia Kazanlak



1 – CO_2 emissions (combustion in boilers)
2 – CO_2 missions (electricity from grid)
Fig. 2.1.3.1 - Flowchart of current delivery system with it's the main components and their connections for Toplofikatsia Kazanlak.

2.2 Flowchart of the situation after the implementation of the project

2.2.1 Flowchart of the situation after the implementation of the project at Polimeri Devnia



1 – Direct on-site CO_2 emissions (comb in CHP)
2 – Direct off-site CO_2 emissions (electricity from grid)
3 – Direct off-site CO_2 emissions (comb in back up TPS boilers)

Fig. 2.2.1.1 - Flowchart of the situation after the implementation of the project at Polimeri Devnia

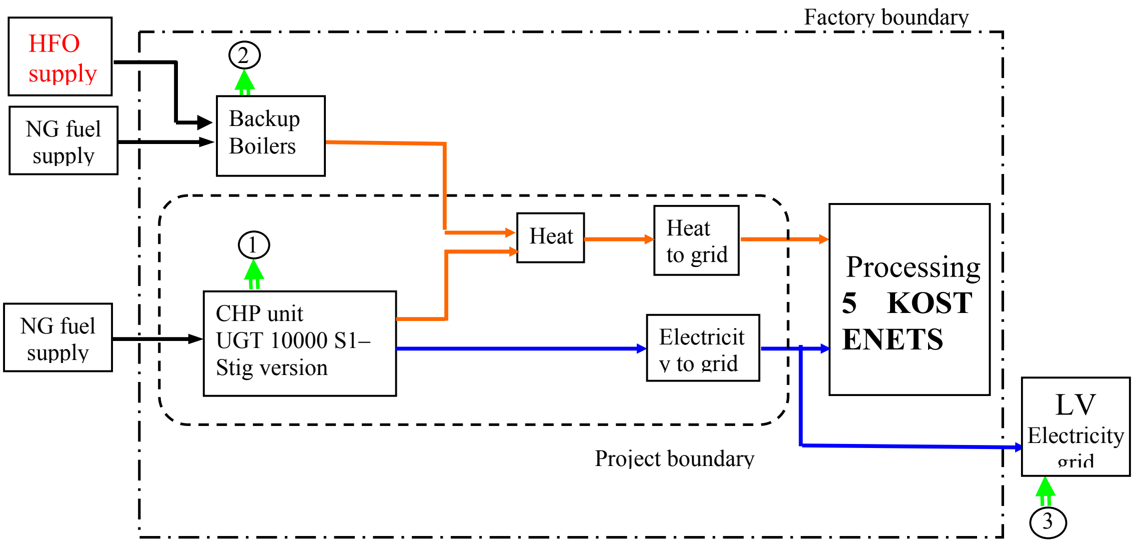
Direct and indirect emissions

With this definition of the project boundary, the Project and Baseline emissions, both ***On-site and Off-site*** are as shown in Table 2.2.2.1 below:

On-site emissions			
Project	**Current situation**	**Direct or indirect**	**Include or exclude**
CO_2 emissions from NG combustion in CHP		Direct	Include
Off-site emissions			
Project	**Current situation**	**Direct or indirect**	**Include or exclude**
CO_2 emissions from coals combustion in TPS back-up boilers		Direct	Exclude
	CO_2 emissions from coals combustion in TPS boilers	Direct	Include
	CO_2 emissions from electricity grid	Direct	Include
CO_2 emissions to electricity grid		Indirect	Include

Table 2.2.2.1 – On-site and Off-site, Direct and Indirect, Project and Baseline emissions at Polimeri

2.2.2 Flowchart of the situation after the implementation of the project at Kostenets HHI



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

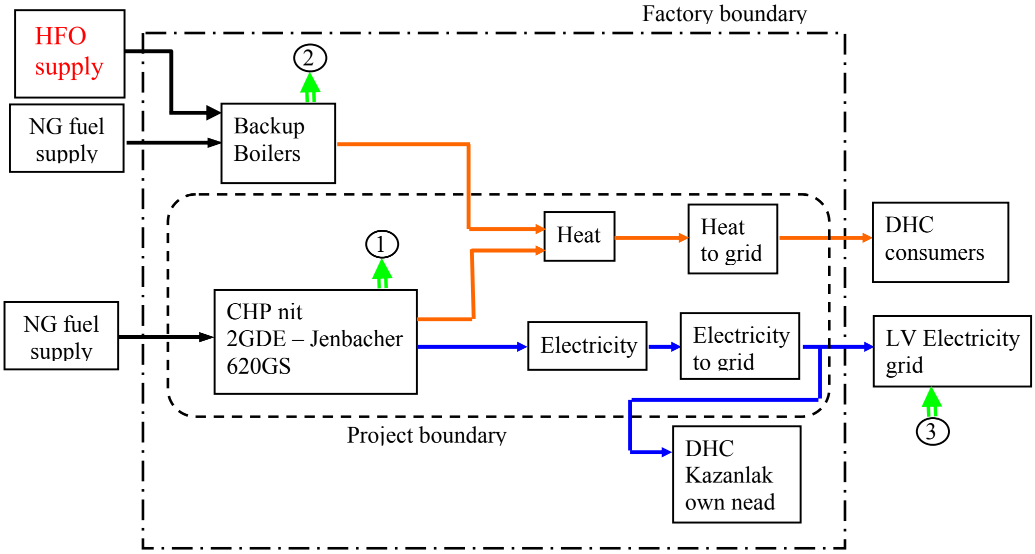
Direct and indirect emissions

With this definition of the project boundary, the Project and Baseline emissions, both *On-site and Off-site* are as shown in Table 2.2.2.1:

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

2.2.3 Flowchart of the situation after the implementation of the project at Toplofikatsia Kazanlak



1 – Direct on-site CO_2 emissions (combustion in CHP)
2 – Direct off-site CO_2 emissions (combustion in back up boilers)
3 – Indirect off-site CO_2 avoided emissions (electricity to grid)

Fig. 2.2.3.1 - Flowchart of the situation after the implementation of the project at Toplofikatsia Kazanlak

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 2.2.3.1:

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 2.2.3.1 – On-site and Off-site, Direct and Indirect, Project and Baseline emissions at Toplofikatsia Kazanlak

2.3 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

2.3.1 Estimation of Polimeri Devnia baseline emissions

Emission factors are determined by:

1) For the first baseline emission component: **CO_2 combustion** is associated with the combustion of coal in existed boilers in TPS; The boilers use black coals from type "T", "TP". In accordance with Bulgarian Inventory 2002 the emission factors for black and anthracite coals are the same 0.101 $ktCO_2$/ TJ. We accept conservative value for the emission factor of EFmg =0.0983 Kton/TJ – source IPCC 2006.

2) For the second baseline emission component: **CO_2 electricity** – look the text above in point 2.3.

Annual coals consumption in boilers – ABNG in order to cover expected heat demands 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 POLIMERI, TJ/y

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

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

Where: EFac = 0.0983 Kton CO_2/TJ – emission factor for black coal 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:

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

Where: CEO [MWh/y]– annual electricity production of CHP in POLIMERI.
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 Polimeri Devnia.xls.

2.3.2 Estimation of Kostenets HHI baseline emissions

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 2.3 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:

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

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:

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

Where: CEO [MWh/y]– annual electricity production of CHP in POLIMERI.
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:

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

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

2.3.3 Estimation of Toplofikatsia Kazanlak baseline emissions

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 2.3 above.

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

$$ABNG = ABHEC / e_b, \quad TJ/y$$

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:

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

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:

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

Where: CEO [MWh/y]– annual electricity production of CHP in Toplofikatsia.

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:

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

The results are presented in monitoring model – File Monitoring PDD Toplofikatsia Kazanlak.xls.

2.4 Estimation of the project emissions

2.4.1 Estimation of Polimeri Devnia project emissions

The following estimation procedures are 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 read from the measurement devices /Gas Flowmeters/ on Month base:

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

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

- **Direct off-site emission according to project boundary are:**

We measure the total produced steam from CHP (gas turbine modules and additional burners), and this is the base for calculation of the project emissions. The estimation procedure is shown above. The steam produced from backup boilers in TPS Deven, steam with pressure 35 barg – continuously and 22 barg and 16 barg in case of shortage in CHP production, are measured separately. The factory pay of TPS Deven for the steam supply. The supply of steam from TPS Deven is continuation of the existing situation before the project implementation and is not part from baseline and project scenario. The combustion of coals are accomplish on the territory of other juridical person. In the baseline and project scenario we consider only the quantities of steam produced from CHP i.e. in our case the direct off-site emissions from coals combustion in TPS Deven are accepted of zero (their influence on the project is zero).

CO_2 emissions caused by additional electricity from grid, in order to cover electricity consumption of POLIMERI **(ABEC – CEO)**, are not estimated because equal values participate in baseline and in project emissions.

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

CO2 emissions generated in the NEC grid from not definite power source, normally Coals Electrical

Power Stations and replaced from the generated, over the factory consumption, exceed electricity of CHP.

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

Where: FEel,gen [tCO_2/MWh] – is emission factor for generated electricity in Bulgaria
AEI [MWh/y] – annual electricity export to NEC grid.

Total CO_2 project emissions from the project implementation are:

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

The project emissions results are presented in monitoring model – File Monitoring PDD Polimeri Devnia.xls.

2.4.2 Estimation of Kostenets HHI 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}

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

- **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:

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

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.

$$AEI = ABEC – CEO, \quad MWh/y$$

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}

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

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

Total CO_2 emissions from the project implementation are:

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

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

2.4.3 Estimation of Toplofikatsia Kazanlak 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, 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}

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

- **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 Toploficatsia 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 wit 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:

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

CO_2 emissions, avoided from the replaced electricity is PErgrid. The negative difference between annual baseline electricity consumption of Toplofikatsia Kazanlak – ABEC and annual electricity output of CHP – CEO show that AEI is el.production for selling, which replace the electricity to grid for Toplofikatsia

Kazanlak. 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.

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

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

<u>Indirect off-site avoided CO_2 emission - replaced electricity to grid - PE_{grid}</u>

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

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

<u>Total CO_2 emissions from the project implementation are:</u>

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

The project emissions results are presented in monitoring model – File Monitoring PDD Toplofikatsia Kazanlak.xls

2.5 Estimation of CO_2 emission reductions

2.5.1 Estimation of Polimeri Devnia CO_2 emission reductions

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

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

<u>Remark:</u> 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 Polimeri Devnia.xls.

2.5.2 Estimation of Kostenets HHI CO_2 emission reductions

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

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

<u>Remark:</u> 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.

2.5.3 Estimation of Toplofikatsia Kazanlak 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 Toplofikatsia Kazanlak.xls.

3. Monitoring

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

3.1 Data monitored

The data are and will be collected on a monthly basis during the crediting period (including 2013). 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 plants and back-up boilers, in Nm^3.
- The net electricity supplied by the cogeneration plant to the factory, in MWhe
- The exchanged electricity with the electricity grid, in MWhe
- Net heat supplied by cogeneration plant to the factory, in GJ
- Heat supplied by back-up boilers, in GJ

For the specific project considerations in this 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 this PDD. The monitoring models takes 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 are 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 exchanged with 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

The structure and the procedures of monitoring in the period of project operation are:
<u>Staff at subprojects</u>

- 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);

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 in the separate subprojects 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.

Principally 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 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 buyers (NEC or the Electrical Distribution Companies), 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.

3.2 Measurement schemes 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 :

3.2.1 Measurement scheme and measurement devices at Polimeri Devnia CHP

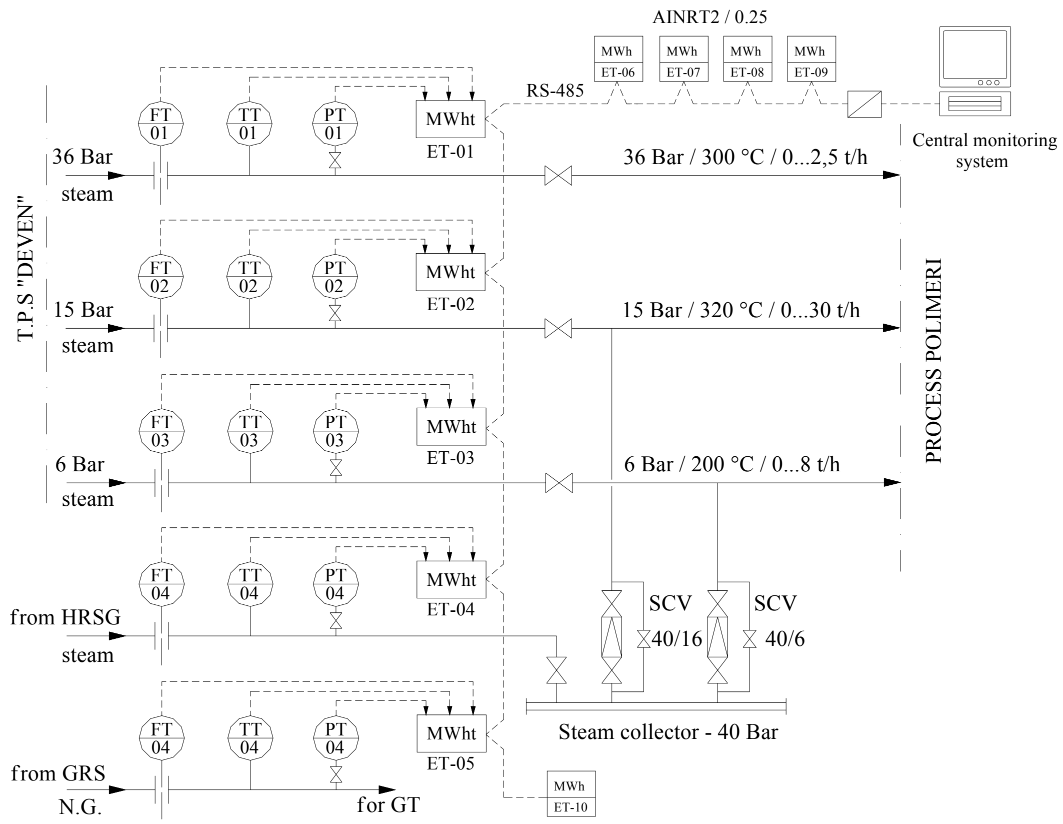


Fig. 3.2.1 - Measurement scheme at Polimeri Devnia CHP

Position on the measurement scheme	Measured Parameter		Measurement method	Measurement device model	Measurement range
	Parameter	Dimens.			

Table 3.2.1 - Short measurement devices description Polimeri CHP

3.2.2 Measurement scheme and measurement devices at Kostenets HHI CHP

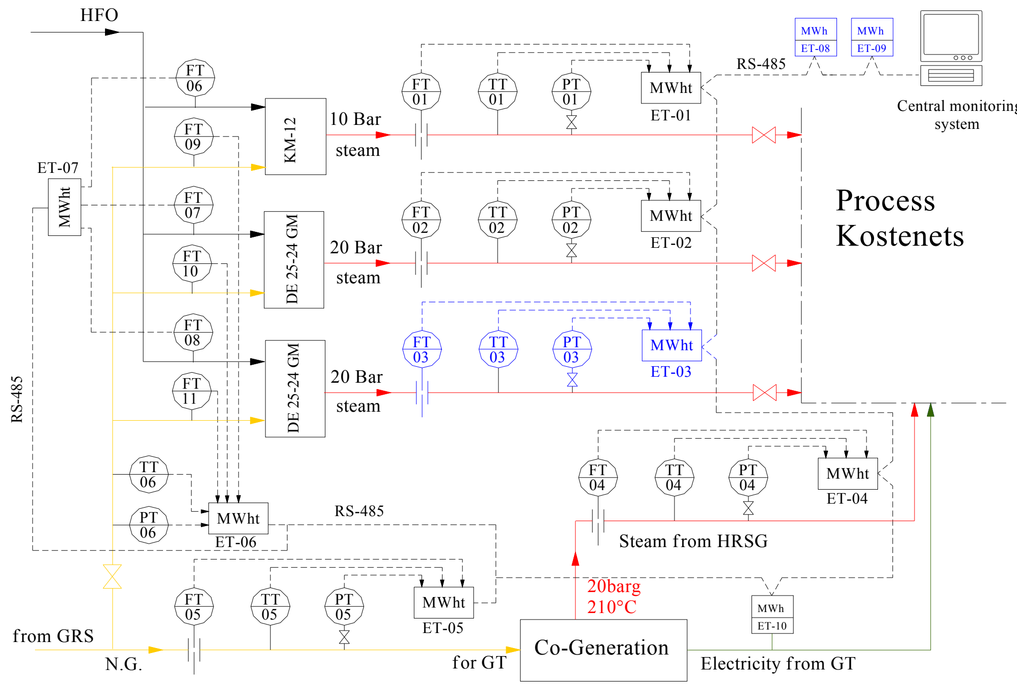


Fig. 3.2.1 - Measurement scheme at Kostenets HHI CHP

Position on the measurement scheme	Measured Parameter		Measurement method	Measurement device model	Measurement range
	Parameter	Dimens.			

Table 3.2.1 - Short measurement devices description Kostenets HHI CHP

3.2.2 Measurement scheme and measurement devices at Toplofikatsia Kazanlak CHP

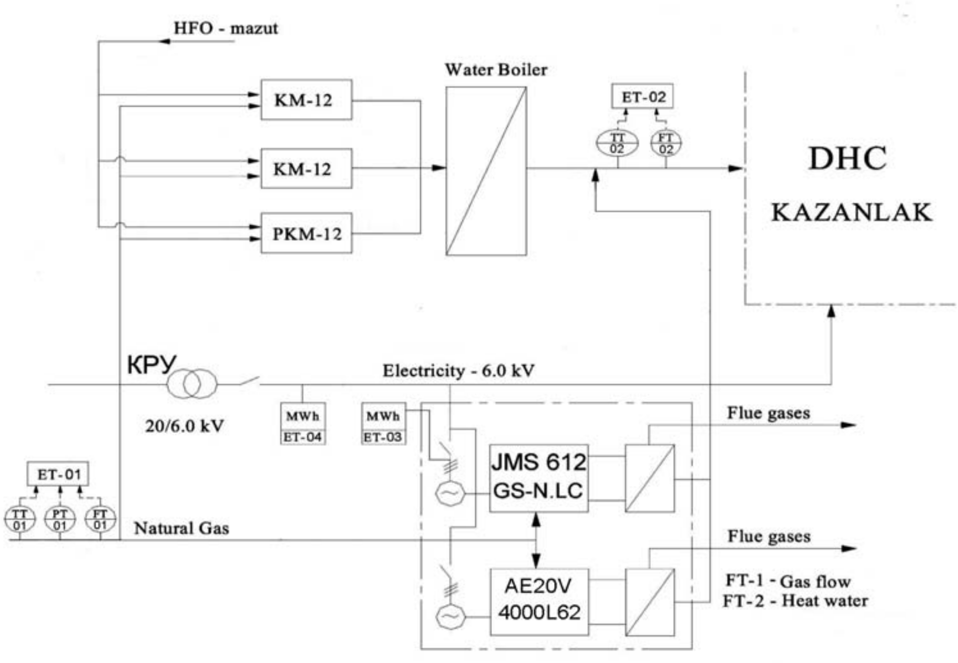


Fig. 3.2.1 - CHP measurement scheme at Toplofikatsia Kazanlak

Position on the measurement scheme	Measured Parameter		Measurement method	Measurement device model	Measurement range
	Parameter	Dimens.			
ET-01	Natural gas	Nm^3	Turbine with P and T°C corrections	RVG-250	440-4400 nm^3
ET-02	Heat water	MWh	Orifice plate	Ikoterm FH21	1-9 MWh
ET-03	Electricity	MWh	Electronically in PLC Scheme 3 transformers	With CHP /PLC/	0-2,5 MWh
ET-04	Electricity	MWh	Electronically Scheme 3 transformers	Actaris SL7000	0-12,5 MWh

Table 3.2.1 - Short measurement devices description CHP Toplofikatsia Kazanlak

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.

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 01.01.2008 to the end of 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:

4.1 Measurement data 2008 collection at Polimeri Devnia

Annual consumption

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

Month	2006	2007	2008	2009	2010	2011	2012
Jan							
Feb							
Mar							
Apr							
May							
Jun							
Jul							
Aug							
Sep							
Oct							
Nov							
Dec							
Total	0	0	0	0	0	0	0

Production of steam from CHP and additional burners (AB) ; [MWh]

Month	2006	2007	2008	2009	2010	2011	2012
Jan							
Feb							
Mar							
Apr							
May							
Jun							
Jul							
Aug							
Sep							
Oct							
Nov							
Dec							
Total	0	0	0	0	0	0	0

Generated electricity from CHP; [MWh]

Month	2006	2007	2008	2009	2010	2011	2012
Jan							
Feb							
Mar							
Apr							
May							
Jun							
Jul							
Aug							
Sep							
Oct							
Nov							
Dec							
Total	0	0	0	0	0	0	0

Generated electricity export to NEC grid; [MWh]

Month	2006	2007	2008	2009	2010	2011	2012
Jan							
Feb							
Mar							
Apr							
May							
Jun							
Jul							
Aug							
Sep							
Oct							
Nov							
Dec							
Total	0	0	0	0	0	0	0

4.2 Measurement data 2008 collection at Kostenets HHI

Annual consumption

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

Mont	2006	2007	2008	2009	2010	2011	2012
Jan							
Feb							
Mar							
Apr							
May							
Jun							
Jul							
Aug							
Sep							
Oct							
Nov							
Dec							
Total	0	0	0	0	0	0	0

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

Mont	2006	2007	2008	2009	2010	2011	2012
Jan							
Feb							
Mar							
Apr							
May							
Jun							
Jul							
Aug							
Sep							
Oct							
Nov							
Dec							
Total	0	0	0	0	0	0	0

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

Mont	2006	2007	2008	2009	2010	2011	2012
Jan							
Feb							
Mar							
Apr							
May							
Jun							
Jul							
Aug							
Sep							
Oct							
Nov							
Dec							
Total	0	0	0	0	0	0	0

Generated electricity CHP; [MWhe]

Mont	2006	2007	2008	2009	2010	2011	2012
Jan							
Feb							
Mar							
Apr							
May							
Jun							
Jul							
Aug							
Sep							
Oct							
Nov							
Dec							
Total	0	0	0	0	0	0	0

CHP generated electricity exported to NEC grid; [MWhe]

Mont	2006	2007	2008	2009	2010	2011	2012
Jan							
Feb							
Mar							
Apr							
May							
Jun							
Jul							
Aug							
Sep							
Oct							
Nov							
Dec							
Total	0	0	0	0	0	0	0

4.3 Measurement data 2008 collection at Toplofikatsia Kazanlak

Natural gas for CHP and BB ; [x 1000 Nm3]

Mont	2006	2007	2008	2009	2010	2011	2012
Jan	0	0	313.019				
Feb	0	0	335.491				
Mar	0	0	319.896				
Apr	0	0	251.104				
May	0	0	0				
Jun	0	0	0				
Jul	0	0	0				
Aug	0	0	0				
Sep	0	0	285.789				
Oct	0	0	323.542				
Nov	0	0	296.962				
Dec	0	0	398.034				
Total	**0**	**0**	**2523.837**	**0**	**0**	**0**	**0**

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

Mont	2006	2007	2008	2009	2010	2011	2012
Jan	0	0	0				
Feb	0	0	0				
Mar	0	0	0				
Apr	0	0	0				
May	0	0	0				
Jun	0	0	0				
Jul	0	0	0				
Aug	0	0	0				
Sep	0	0	0				
Oct	0	0	0				
Nov	0	0	0				
Dec	0	0	0				
Total	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Production of steam from CHP and Backup Boiler ; [MWht]

Mont	2006	2007	2008	2009	2010	2011	2012
Jan	0	0	2356.775				
Feb	0	0	1951.023				
Mar	0	0	1333.020				
Apr	0	0	942.099				
May	0	0	0				
Jun	0	0	0				
Jul	0	0	0				
Aug	0	0	0				
Sep	0	0	1040.000				
Oct	0	0	1083.436				
Nov	0	0	1214.660				
Dec	0	0	1788.605				
Total	**0**	**0**	**11709.618**	**0**	**0**	**0**	**0**

Generated electricity CHP; [MWhe]

Mont	2006	2007	2008	2009	2010	2011	2012
Jan	0	0	0.000				
Feb	0	0	687.800				
Mar	0	0	1182.200				
Apr	0	0	1131.500				
May	0	0	0.000				
Jun	0	0	0.000				
Jul	0	0	0.000				
Aug	0	0	0.000				
Sep	0	0	1021.900				
Oct	0	0	1175.000				
Nov	0	0	1089.020				
Dec	0	0	1501.200				
Total	**0**	**0**	**7788.62**	**0**	**0**	**0**	**0**

CHP generated electricity exported to NEC grid; [MWhe]

Mont	2006	2007	2008	2009	2010	2011	2012
Jan	0	0	0				
Feb	0	0	640.8				
Mar	0	0	1103.4				
Apr	0	0	1071				
May	0	0	0				
Jun	0	0	0				
Jul	0	0	0				
Aug	0	0	0				
Sep	0	0	972				
Oct	0	0	1170				
Nov	0	0	1026				
Dec	0	0	1494				
Total	**0**	**0**	**7477.2**	**0**	**0**	**0**	**0**

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

Mont	2006	2007	2008	2009	2010	2011	2012
Jan	0	0	8020	0	0	0	0
Feb	0	0	8013	0	0	0	0
Mar	0	0	8021	0	0	0	0
Apr	0	0	8021	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	8031	0	0	0	0
Oct	0	0	8031	0	0	0	0
Nov	0	0	8027	0	0	0	0
Dec	0	0	8055	0	0	0	0
Average	**0**	**0**	**8027**	**0**	**0**	**0**	**0**

Natural gas for CHP and BB consumption ; [GJ]

Mont	2006	2007	2008	2009	2010	2011	2012
Jan	0	0	10510.59	#VALUE!	#VALUE!	#VALUE!	#VALUE!
Feb	0	0	11255.33	#VALUE!	#VALUE!	#VALUE!	#VALUE!
Mar	0	0	10742.85	#VALUE!	#VALUE!	#VALUE!	#VALUE!
Apr	0	0	8432.656	#VALUE!	#VALUE!	#VALUE!	#VALUE!
May	0	0	0	#VALUE!	#VALUE!	#VALUE!	#VALUE!
Jun	0	0	0	#VALUE!	#VALUE!	#VALUE!	#VALUE!
Jul	0	0	0	#VALUE!	#VALUE!	#VALUE!	#VALUE!
Aug	0	0	0	#VALUE!	#VALUE!	#VALUE!	#VALUE!
Sep	0	0	9609.424	#VALUE!	#VALUE!	#VALUE!	#VALUE!
Oct	0	0	10878.84	#VALUE!	#VALUE!	#VALUE!	#VALUE!
Nov	0	0	9980.134	#VALUE!	#VALUE!	#VALUE!	#VALUE!
Dec	0	0	13423.57	#VALUE!	#VALUE!	#VALUE!	#VALUE!
Total	**0**	**0**	**84833.39**	**#VALUE!**	**#VALUE!**	**#VALUE!**	**#VALUE!**

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.

5.1.1 Baseline emissions calculation Polimeri Devnia

CHP 2 x Centrax 501 KB7 Heat production

Year	Year	h production boilers in TSP	Steam production for CHP MWh/year	Replleiced head from CHP GJ/year	CO2 emissions (combustion) t/year
1	2006	0.85	0	0.0	0.0
2	2007	0.85	0	0.0	0.0
3	2008	0.85	0	0.0	0.0
4	2009	0.85	0	0.0	0.0
5	2010	0.85	0	0.0	0.0
6	2011	0.85	0	0.0	0.0
7	2012	0.85	0	0.0	0.0

CHP 2 x Centrax 501 KB7 ELECTRICITY

Year	Year	Electricity production of CHP export (Replaced generation of NEC grid)	Electricity production of CHP for consumption of factory replacing	**EFELcons.** 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	0	0.000	0.0
5	2010	0	0	0.000	0.0
6	2011	0	0	0.000	0.0
7	2012	0	0	0.000	0.0

5.1.2 Baseline emissions calculation Kostenets HHI

CHP 2 x Centrax 501 KB5 Heat production

Year	Year	**h** production BB	Steam production for CHP and BB	Replleicet 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	0	0	0.0
5	2010	0.89	0	0	0.0
6	2011	0.89	0	0	0.0
7	2012	0.89	0	0	0.0

CHP 2 x Centrax 501 KB5 **ELECTRICITY**

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	0	0.000	0.0
5	2010	0	0	0.000	0.0
6	2011	0	0	0.000	0.0
7	2012	0	0	0.000	0.0

5.1.3 Baseline emissions calculation Toplofikatsia Kazanlak

CHP - 1 x JMS 612 GS- N.L.C + 1 x AE 20V4000L62 – HEAT PRODUCTION

Year	Year	η production of Boilers	Steam production of CHP and BB	Produced heat from CHP and BB	CO2 emissions (combustion)
			MWh/year	GJ/year	t/year
1	2006	0.83	0	0	0.0
2	2007	0.83	0	0	0.0
3	**2008**	**0.83**	**11709.6**	**42154.6**	**3931.0**
4	2009	0.83	0	0	0.0
5	2010	0.83	0	0	0.0
6	2011	0.83	0	0	0.0
7	2012	0.83	0	0	0.0

CHP - 1 x JMS 612 GS- N.L.C + 1 x AE 20V4000L62 ELECTRICITY

Year	Year	Electricity production of CHP export to NEC grid (Replaced generation in NEC grid)	Electricity production of CHP for consumption of factory replacing	BEFELcons. replaced consumptionof factory /Netherlands EF consumption/	CO2 baseline emissions
		MWh/year	MWh/year	tCO2/MWh	t/year
1	2006	0	0	0.934	0.0
2	2007	0	0	0.912	0.0
3	**2008**	**7477.2**	**311.42**	**0.89**	**277.2**
4	2009	0	0	0.867	0.0
5	2010	0	0	0.845	0.0
6	2011	0	0	0.822	0.0
7	2012	0	0	0.8	0.0

5.2 Project emissions calculation

The calculations are based on formulas in point 2.4 .

5.2.1 Project emissions calculation for Polimeri Devnia

CHP 2 x Centrax 501 KB7

Year	Year	Natural gas consumption (combustion) in CHP and Add.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	CO2equiv. Emissions Reduction
		GJ/year	MWh/year		t/year	t/year	t/year
1	2006	#NAME?	0	0.0	#NAME?	0	#NAME?
2	2007	#NAME?	0	0.0	#NAME?	0	#NAME?
3	2008	#NAME?	0	0.0	#NAME?	0	#NAME?
4	2009	#NAME?	0	0.0	#NAME?	0	#NAME?
5	2010	#NAME?	0	0.0	#NAME?	0	#NAME?
6	2011	#NAME?	0	0.0	#NAME?	0	#NAME?
7	2012	#NAME?	0	0.0	#NAME?	0	#NAME?

5.2.2 Project emissions calculation for Kostenets HHI

<u>CHP 2 x Centrax 501 KB5</u>

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	CO2equiv. Emissions Reduction
		GJ/year	GJ/year	MWh/year		t/year	t/year	t/year
1	2006	0	#NAME?	0	0.0	#NAME?	0	#NAME?
2	2007	0	#NAME?	0	0.0	#NAME?	0	#NAME?
3	2008	0	#NAME?	0	0.0	#NAME?	0	#NAME?
4	2009	0	#NAME?	0	0.0	#NAME?	0	#NAME?
5	2010	0	#NAME?	0	0.0	#NAME?	0	#NAME?
6	2011	0	#VALUE!	0	0.0	#VALUE!	0	#VALUE!
7	2012	0	#VALUE!	0	0.0	#VALUE!	0	#VALUE!

5.2.3 Project emissions calculation for Toplofikatsia Kazanlak

<u>CHP - 1 x JMS 612 GS- N.L.C + 1 x AE 20V4000L62</u>

Year	Year	HFO consumption (combustion) in BB	Natural gas consumption (combustion) in CHPand BB	Electricity production of CHP Electricity generation to NEC grid	EFel.gen emission factor generation to NEC grid /Netherlands EFs generation/	CO2 Emissions (combustion)	CO2 Emissions generation to NEC grid	CO2 Project emissions
		GJ/year	GJ/year	MWh/year	tCO_2/MWh	t/year	t/year	t/year
1	2006	0	0	0	0.797	0	0	0
2	2007	0	0	0	0.779	0	0	0
3	**2008**	**0**	**84833.4**	**7477.2**	**0.761**	**4759**	**5690**	**-931**
4	2009	0	#VALUE!	0	0.743	#VALUE!	0	#VALUE!
5	2010	0	#VALUE!	0	0.725	#VALUE!	0	#VALUE!
6	2011	0	#VALUE!	0	0.707	#VALUE!	0	#VALUE!
7	2012	0	#VALUE!	0	0.689	#VALUE!	0	#VALUE!

5.3 Emissions reduction calculations

The calculations are based on the formula in point 2.5.

5.3.1 Emissions reduction calculations for Polimeri Devnia

		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	#NAME?	#NAME?
2	2007	0	0	#NAME?	#NAME?
3	2008	0	0	#NAME?	#NAME?
4	2009	0	0	#NAME?	#NAME?
5	2010	0	0	#NAME?	#NAME?
6	2011	0	0	#NAME?	#NAME?
7	2012	0	0	#NAME?	#NAME?

5.3.2 Emissions reduction calculations for 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	#NAME?	#NAME?
2	2007	0	0	#NAME?	#NAME?
3	2008	0	0	#NAME?	#NAME?
4	2009	0	0	#NAME?	#NAME?
5	2010	0	0	#NAME?	#NAME?
6	2011	0	0	#VALUE!	#VALUE!
7	2012	0	0	#VALUE!	#VALUE!

5.3.2 Emissions reduction calculations for Toplofikatsia Kazanlak

		Base Line		**Project Line**	**Reduction**
Year	**Year**	**CO2 Emissions Heat**	**CO2 Emissions Electricity**	**CO2 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**	**3931**	**277**	**-931**	**5139**
4	2009	0	0	#VALUE!	#VALUE!
5	2010	0	0	#VALUE!	#VALUE!
6	2011	0	0	#VALUE!	#VALUE!
7	2012	0	0	#VALUE!	#VALUE!

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