JOINT IMPLEMENTATION PROJECT DESIGN DOCUMENT FORM
Version 01 - in effect as of: 15 June 2006

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SECTION A. General description of the project

A.1. Title of the project:

Reduction of greenhouse gases by gasification of Burgas Municipality
Version 08, November 2007

A.2. Description of the project:

A.2.1 Abstract

The project aims at reduction of greenhouse gases (GHG) in Burgas municipality by fuel switch from liquid and solid fuels and electricity, used by industrial, public and administrative consumers and households to natural gas and by enhancement of the energy efficiency of their combustion installations.

The project covers the construction of gas distribution network in Burgas Municipality, reconstruction of the combustion installations of the end users in the industrial, public and administrative and residential sectors, and the delivery of emission reduction units.

The development of the project as a Joint Implementation Project under the Kyoto Protocol Mechanisms will contribute to the fulfillment of the commitments under the Kyoto Protocol.

A.2.2. Objectives of the project

- Delivery of natural gas to the end users by construction of gas distribution network;
- Reconstruction of the combustion installations of the end users in industrial, public and administrative, and residential sectors;
- Switch from solid and liquid fuels, and electricity to natural gas;
- Enhancement of the energy efficiency;
- Reduction of greenhouse gas emissions and delivery of emission reductions under the Joint Implementation Mechanism.

A.2.3. Scope of the project

The project foresees 230 400 m of gas distribution network from steel and PE-HD pipelines and 41 700 m of gas branch lines to be built till 2017 and the end users' installations to be reconstructed.
The potential consumers of natural gas are grouped in three sectors: industrial, public and administrative, and residential. The main parameters, on which this conditional division is based, are:

- The nature of each consumer group's activity and the purpose of the used fuel (production, commerce, residential use);
- Amount of the annual energy consumption;
- Installed energy capacity;
- Energy source, alternative to the natural gas.

Currently on the territory of the project, Burgas Municipality, the only consumer of natural gas is the heating plant (HP) Burgas (since 1994). The industrial, public and administrative, and residential consumers don't use natural gas. The main reason for this is the lack of main gas distribution pipelines and a gas distribution network to ensure access to natural gas for the users in the public and administrative and residential sectors.

A Marketing Report on the Gasification and Distribution of Natural Gas in Burgas was made in April 2005. The report is based on the expected development in industry and housing by zones. The market

researches conducted by Overgas Inc. AD show increased interest on behalf of the potential consumers of natural gas in an accelerated implementation of the project, in changing their combustion system and in enhancement of the energy efficiency.

The natural gas market assessment is based on:

- Pre-investment studies on the development of the overall gas and heat supply systems of Burgas;
- Detailed market research related to the gasification of Burgas, done by experts from the Marketing and Sales Department of Overgas Inc. AD.

The administrative and territorial division of the city in differentiated zones and a digitalized model have been applied.

The municipality has two differentiated industrial zones, the Northern and the Southern, which include about 40 large enterprises representing various industrial branches. A compact Northern part of the municipality includes: residential complex (r.c.) Slaveykov, r.c. Izgrev, r.c. Zornitsa, r.c. Lazur, r.c. Vazrajdane, r.c. Bratia Miladinovi, r.c. Republika, Central city part, complex Meden Rudnik, two residential districts: Akaciite and Pobeda included in the Southern industrial zone and residential districts Lozovo, Kraimorie, Sarafovo, Dolno Ezerovo i Gorno Ezerovo.

- **Industrial sector**

Burgas is an administrative centre of the South-Eastern region of the Republic of Bulgaria. A characteristic feature of the region's economy is the well-developed infrastructure, including an international airport, several port complexes and a railroad junction. This serves as grounds for the development of transport and storage services, of the commerce, of development of oil refining factories. Widely participating processing industry ensures not only higher employment rate compared to the average for the country, but also gives an opportunity for development and operation of the activities of the concomitant production and services, provided mainly by small and medium enterprises. Other important sectors are food industry (fish canning), electric appliances and electronics industries as well as machine building (construction of railroad freight cars, metal-cutting machines, tanker fleet) and metalworking. On the territory of Bulgaria some of these productions are developed only in Burgas. Small and medium enterprises operate mainly in the services sector and have a growing role in the economy.

The main industrial consumers for the project are: Pobeda AD, Port Burgas EAD, El Cabel, Trans vagon, Sladkar 2000 OOD and Hemus Mark. Development of new industrial zones can be expected in the areas to the north of Prof. Yakim Yakimov blv. and along the road Burgas-Aytos.

It is planned that during the period 2006-2017 100% of the currently existing industrial consumers in Burgas will switch to natural gas.

- **Public and administrative sector**

Burgas municipality has higher education institutions, vocational schools, specialized in different fields, schools of general education and kindergartens. Commercial activities are implemented mainly by catering, shops for food and other consumer commodities, markets, workshops for services, offices. The Municipality of Burgas has a very good potential for the development of various forms of tourism. The favourable climate, existence of natural and historical sites and development of popular art crafts give preconditions for development of four season recreation, sports and tourism service.

There are three large hospitals on the territory of the municipality, which use energy throughout the entire year, as well as policlinics and medical centres. Two higher education institutions, several colleges, vocational schools and many kindergartens are located on the terrirory of Burgas Municipality. Some of the largest consumers are: the hospitals MBAL Burgas and Medical center "St. Sofia"; the Universities Prof. Asen Zlatarov University and Burgas Free University; National School for Musical and Stage Art "Prof. Pancho Vladigerov" Burgas; Theater for drama, opera and ballet (Burgas opera).

It is planned that 100% of the currently existing sites will switch to natural gas until the final stage of the project. The gasification plans include approximately 30 municipal sites on the territory of the municipality. The project provides for the gasification of 170 public and administrative and trading buildings until the end of 2017. The small commercial sites situated in residential buildings have been accounted as potential residential sector consumers. The reasons for this are the specifics of their business, characteristics of supply of natural gas and the alternative way of energy supply.

- **Residential sector**

The population of Burgas municipality as of 31.12.2003 (according to the Burgas Territorial Bureau of Statistics of the National Statistical Institute) is 209 417 persons, and the population of town of Burgas as of 31.12.2003 is 190 507 persons, which is 91% of the municipality's population. The population of Burgas Municipality is distributed in 70 558 households.

Burgas has an existing central heating grid. The major share in sales of heat energy, delivered by means of heated water, is attributed to households as the service of Toplofikacia Burgas EAD is used by 45 % of the population of Burgas. The consumers are located mainly in the residential complexes, such as Slaveykov, Izgrev, Zornitsa, and in the complexes partially supplied with central heating, such as Lazur and Bratia Miladinovi.

At the current stage of the Burgas project, **no entering** into centrally heated residential zones is planned. Gasification of over 23 500 households is expected during the planned period, which is 62% of the not connected to central heating households on the Burgas territory.

The project "Reduction of greenhouse gases by gasification of Burgas Municipality" foresees achievement of 55.6 million sm^3 natural gas sales in 2017 and 315 904 tons of greenhouse gas emission reductions for the period 2008-2012.

A.2.4. Stages of the project

A.2.4.1. General status

The development of gasification projects starts with the construction of the main gas distribution pipelines and facilities, as well as with the gasification of the industrial consumers. The project continues with the gasification of the public and administrative and commercial sites and gradual gasification of the households. The gasification in the residential sector continues with densification of the already constructed network. In case any alterations in the layout of existing built-up zones or construction of new zones occur, additional gas distribution network to such zones is constructed. The expansion in the urban zones and densification of the network continue.

A.2.4.2. Preparation for the beginning of the project

The preparation started with documents, made and approved on corporate level, as follows:

- General plan for the gasification of Burgas – made in 1999; submitted to the Burgas Municipality in the year 2000 and approved by the Municipal Council on 31 July 2002;
- Tender for the gasification of Burgas – made in 1997 in relation to a bidding procedure announced by the Burgas municipality; updated and re-submitted to the Municipal Council in the year 2000.

The following documents were completed in 2005:

- Detailed marketing surveys;
- Updated digital model of the aboveground and underground cadastre;
- Preliminary design;
- Detailed structural plan of the routes of gas distribution pipelines located outside the urban territory of the city;
- Applications to the Regional Inspectorate of Environment and Water (RIEW) Burgas, for decision on the necessity of environmental impact assessment (EIA) of the investment proposals covering the territories with which the project construction starts, for which the RIEW Burgas, by its Decision # БС-353-ПР/2005, Decision # БС-364-ПР/2005, Decision # БС-379-ПР/2005, Decision # БС-215-ПР/2006 and Decision # БС-216-ПР/2006, has decided that for the sites EIA is not necessary, (*Annex 10*);
- Design documentation for the gas distribution network planned to be constructed during the first year;
- Licenses of Gazosnabdyavane Burgas EAD for "distribution of natural gas" (License № Л-189-08/03.06.2005) and for "public supply of natural gas" on the territory of Burgas municipality (License № Л-189-12/03.06.2005).

A.2.4.3. Construction stages

The town of Burgas is divided into 6 zones. The zone map of Burgas has been made on the basis of a sociological study of consumer interest, assessment of solvent demand, of the possible speed of construction and natural route of the gas. Zone 1 has the best characteristics (density, real estate market and concentration of services), followed by zone 2, zone 3, zone 4, zone 5 and zone 6.
In *Annex 4* the conclusion from the conducted among the Burgas population researches on the natural gas market are presented.

The zone division of the territory of Burgas is based on the following main criteria:

- Coverage of areas without central heating systems;
- Density and intensity of built-up areas;
- Attractiveness of the area;
- Availability of infrastructure (proximity to existing gas pipelines);
- Availability of approved cadastral plans.

Zone 1

The construction of the gas distribution network will start in 2006.
The construction is expected to be completed in 2008.
The territory of this zone includes the Northern Industrial Zone, parts of Vazrajdane residential complex and Bratia Miladinovi residential complex, as well as part of the Southern Industrial Zone.

Zone 2

The construction of the gas distribution network is planned to start in 2007.
The construction is expected to be completed in 2009.
The territory of this zone includes part of the Southern Industrial Zone, part of Bratia Miladinovi residential complex and the city centre (the Administrative Centre).

Zone 3

The construction of the gas distribution network is planned to start in 2008.
The construction is expected to be completed in 2011.

The territory of this zone includes the remaining part of the Central city area (Administrative Centre) and the section of Lazur residential complex, which does not have a central heating system.

Zone 4

The construction of the gas distribution network is planned to start in 2009.
The construction is expected to be completed in 2014.
Completion of the GDN in the central area of the city and construction of GDN to Meden Rudnik 1 and 2 district.

Zone 5

The construction of the gas distribution network is planned to start in 2010.
The construction is expected to be completed in 2014.
Completion of the construction of GDN to Meden Rudnik district 3 and 4 and to the family houses on the territory.
Construction of GDN to Sarafovo district.

Zone 6

The construction of the gas distribution network is planned to start in 2011.
The construction is expected to be completed in 2014.
Construction of GDN to Kraimorie district.

After this the gasification continues with the densification of the already built network.

In *Annex 5* is presented the plan for construction of the gas distribution networks and branches by years.
In *Annex 6* the plan for gasification of the end users from the three sectors by years is shown.

A.2.5. Expected results at the end of the period

At the end of 2017, it is expected that over 23 400 consumers from the three sectors will be connected with the following annual consumption of natural gas:

Industrial sector*	187 consumers	15.5 million sm^3
Public and administrative sector	170 consumers	12.2 million sm^3
Residential sector	over 23 000 households	27.9 million sm^3
Total		**55.6 million sm^3**

**The consumption of Kronospan Bulgaria EOOD is excluded.*

In *Annex 7* are presented the expected sales of natural gas by years.
As a result of the project implementation (incl. 2017) 924 771 tons greenhouse gas emission reductions will be generated.

A.3. Project participants:

*Parties involved**	*Legal entity that participate in the project (in case such is available)*	*Wish of the Party involved to be consider as project participant (Yes/No)*
Bulgaria*	Overgas Inc. AD – **Supplier** of emission reduction units	No
Denmark	The Danish Government through Danish Environmental Protection Agency under the program Danishcarbon.dk	No

** Host Party involved*

A contact information on the Parties, project partners and the other participants is given in *Annex 1.*

A.4. Technical description of the project:

A.4.1. Location of the project:

The project covers the territory of Burgas Municipality, which is situated on the Southern Black Sea shore of the Republic of Bulgaria.

A.4.1.1. Host Party(ies):

Republic of Bulgaria

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

Eastern Europe, Republic of Bulgaria, Burgas Region, Burgas Municipality

A.4.1.3. City/Town/Community etc.:

The municipality Burgas includes 15 built-up areas, two of which are towns - Burgas and Bulgarevo; and 13 villages – Banevo, Bratovo, Bryastovets, Vetren, Dimchevo, Draganovo, Izvorishte, Marinka, Mirolyubovo, Ravnets, Rudnik, Tvarditsa and Cherno More.

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Fig. 1: Map of the Republic of Bulgaria and Burgas Municipality

A.4.1.4. Detail of physical location, including information allowing the unique identification of the project:

The project boundaries follow the boundaries of Burgas Municipality. Burgas is located on the Black Sea shore, by the Burgas gulf, in a plane known as the Burgas Plate. Burgas is a regional and municipal center at a distance of 390 km to the East from the Capital Sofia.

The population of Burgas Municipality counts over 209 000 persons. Burgas is the second largest on the Bulgarian Black Sea coast regional center after the city of Varna, and it is the fourth largest city in Bulgaria after Sofia, Plovdiv and Varna. It is situated on the most Western tip of the Burgas Gulf on a peninsula surrounded by three firth lakes – the Burgas Lake, the Atanasovsko Lake (to the North) and the Mandrensko Lake (to the Southwest).

Location in comparison with the national gas transmission network

The national gas transmission network, existing near Burgas, consists of: a gas main branch from the Southern main semi-ring (length to the Burgas gas distribution station (GDS) – about 48 km and DN 500), with two branches to GRS Burgas and AGRS Debelt.

A Map of Burgas Municipality is presented in *Annex 8.*

A.4.2. Technology(ies) to be employed, or measures, operations or actions to be implemented by the project:

Gazosnabdyavane Burgas EAD is a subsidiary company of Overgas Inc. AD established for the implementation of the project. As a shareholder of 100% of equity capital Overgas Inc. AD manages and controls the company. Gazosnabdyavane Burgas EAD is the "operating" company, which will sell natural gas to the end users.

Gazosnabdyavane Burgas EAD will operate the gas distribution network and related facilities on their bringing to use on the territory of Burgas municipality.

Gazosnabdyavane Burgas EAD holds the Licenses for "distribution of natural gas" (License № ЛИ-189-08/03.06.2005) and for "public supply of natural gas" on the territory of Burgas Municipality (License № ЛИ-189-12/03.06.2005).

Construction of the gas distribution networks
The gas distribution networks on the territory of Burgas municipality are to be constructed by Overgas Engineering AD. The company uses modern technologies and devices in its work. The technologies which will be used during the implementation of the project have been tested and used during the construction of gas distribution networks.

Overgas Engineering AD is certified to ISO 9001:2000 and ISO 14001:2004.
The gas distribution networks will be constructed mainly by PE-HD 80 and 100 gas pipelines and fittings. The used technology of welding polythene pipes guarantees the quality of joints and high reliability of the gas networks.

The company also has all requisite equipment for construction of steel gas pipelines by manual electric arch welding and welding in gas-protected environment.

Overgas Engineering AD is experienced in construction of gas distribution pipelines and branches using the technology of trenchless laying of the pipelines which is in accordance with the ambitions for environment protection.

The switch to a new fuel involves construction of new or reconstruction of the existing combustion installation of the consumers. Gas equipment and appliances manufactured by leading companies with quality guarantee are used for the construction of indoor installations.

The constructed gas distribution networks are put into operation on the basis of Permit for utility operation issued by the State Directorate for Supervision of Construction. The Permit for utility operation is being issued on the basis of the final report, made by the person responsible for the construction supervision and Protocol Form No 16 certifying the suitability for operation of the project constituted by the State Certifying Commission (SCC) with recommendation for issuance of permit for operation.

Reconstruction of combustion installation to work with natural gas
The reconstruction of the combustion installations of boiler stations in the industrial and public and administrative sites is done by the replacement of only the liquid fuel burners of boilers. The reconstruction of solid fuel boilers depends on the boiler type. A repair of the boiler station may be required, depending on the technical condition of the boilers. New building and apartment gas installations are to be constructed in family houses and blocks of flats in the residential sector.

Construction of gas installations
The natural gas installations are divided into two groups:

- Industrial gas installations;
- Indoor gas installations.

The industrial gas installations include on-site gas pipelines, gas regulating stations, indoor installations in production buildings, combustion systems, gas appliances and devices in production buildings or outdoors, exhaust ducts and chimneys.

The indoor gas installations include gas pipelines, appliances and exhaust ducts.

The gas installations are to be constructed by use of pipes, fittings, devices and other materials and products with quality certificates or conforming to all applicable requirements.

The technical equipment will be installed by qualified and experienced personnel. The gas installations are put in operation after acceptance by independent Technical Supervision.

A.4.3. Brief explanation of how the anthropogenic emissions of greenhouse gases by sources are to be reduced by the proposed JI project, including why the emission reductions would not occur in the absence of the proposed project, taking into account national and/or sectoral policies and circumstances:

At present the combustion installations of the end consumers use solid and liquid fuels and electricity. The solid and liquid fuels are characterized by high carbon dioxide emission factor and a large amount of greenhouse gases and their precursors (SO_x, NO_x, NMVOC and CO) are emitted from their burning. The switch from solid and liquid fuels to natural gas will result in significant reduciton of the greenhouse gas emissions.

The project takes into account also the emission reductions as a result of switching from currently used electricity for heating and hot water to natural gas. In calculating the emission reductions resulting from the switch from electricity to natural gas a carbon dioxide emission factor defined in "Concise Baseline Study of Bulgarian Electric Power System (EPS). CO_2 Baseline Emission Factor of EPS" (*Annex 2)* is applied.

As a result of enhancement of the energy efficiency of the combustion installations after gasification the energy consumption decreases thus causing a decrease in the greenhouse gas emissions. A substantial decrease of GHG results from the enhancement of the energy efficiency in households due to the low efficiency of the combustion installations before the gasification.

Only some of the large industrial enterprise in Republic of Bulgaria are switched to natural gas. The construction of GDN in cities has started in the recent years and is accompanied by difficulties due to lack of knowledge of natural gas, the need of large investments for the construction of the GDN and the low purchasing capacity of the population and municipalities.

As a result of the project implementation (incl. 2017) total 924 771 greenhouse gas emission reduction units will be generated as follows:

- Until 1st January 2008 (Early credits) 12 849 tCO_{2e}
- In the period 2008-2012 315 904 tCO_{2e}
- In the period 2013-2017 596 018 tCO_{2e}

The implementation of the project under Joint Implementation mechanism is of substantial importance not only because of the funds that will be received from the emission reductions' sale. The availability of a validation report on the estimated project outcomes by an independent company and the approval of the project by the government of the Republic of Bulgaria through the Ministry of Environment and Water also facilitate the obtaining of loans from banks for funding the construction of gas distribution infrastructure. The provision of a substantial financial resource in the initial stage of the project is of significant importance for the pace of its progress by the year 2017.

A.4.3.1. Estimated amount of emission reductions over the crediting period:

Duration of the crediting period – 2008-2012.

Year	*Emission Reductions, tCO_{2e}*
2008	28 830
2009	49 746
2010	66 229
2011	81 342
2012	89 755
Total ERUs	**315 904**
Average Annual ERUs	**63 181**

Table 1: Emission reductions, tCO_{2e}

A.5. Project approval by the Parties involved:

All project partners have signed a Letter of Interest. The project has received Letter of Support (LoS) issued by the Ministry of Environment and Water. *(Annex 9: Letter of Support)*

After completion of the validation of the Project Design Document, the PDD and the validation report will be submitted to the Ministry of Environment and Water with a request for issuing a Letter of Approval (LoA).

After signing the contract for delivery of ERUs Denmark will approve the project with a Declaration of Approval (DA).

SECTION B. Baseline

The project "Reduction of greenhouse gases by gasification of Burgas Municipality" unifies two standard projects:

- Switch from solid and liquid fuels to natural gas;
- Replacement of electricity by natural gas.

The specificity of the gasification projects is connected with the involvement of great number of installations (over 23 800 in Burgas project) and with the consideration of the replacement of the part of the electricity used.

The approach of the CDM methodology ACM 0009 "Consolidated methodology for industrial fuel switching from coal or petroleum fuels to natural gas" [1] has been used in the PDD when calculating the emission reductions resulting from the fuel switch.

For the calculation of the emission reductions resulting from the replacement of electricity by natural gas has been used the emission factor defined in "Concise Baseline Study of Bulgarian Electric Power System (EPS). CO_2 Baseline Emission Factor of EPS" (*Annex 2)* in compliance with the requirements of the methodology for CDM projects ACM 0002 "Consolidated methodology for grid-connected electricity generation from renewable sources"[2].

The on-site project emissions without project implementation (baseline) include the emissions of the combustion installations of the end users on the territory of Burgas municipality. The baseline emissions are related to the level of the end energy consumption, the structure of the fuels used and the type and status of the combustion installations.

B.1. Description and justification of the baseline chosen:

B.1.1 Macroeconomic environment

In the recent years the energy sector in Bulgaria has been characterized by the preparation and conducting of reforms related to financial restructuring, institutional changes, commercial restructuring, amendments to the legislation and change of ownership with a view to modernize of the management and to attract investments.

In this process the natural gas sector plays a key role to our country's economy. A large amount of natural gas currently is used mostly in heating plants and for combined power and heat energy generation, and also as raw material in the industry.

According to data[3] from the Agency for Economic Analyses and Forecasts (AEAF) the real growth of Bulgaria's Gross Domestic Product (GDP) in 2003 and 2004 was 4.5% and 5.6% respectively. The trend of high economic growth has been maintained since the beginning of 2006 as well. In the first half of 2006 the GDP increased by 6% in real terms, which corresponds to the forecasts for a relevant growth of

[1] http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html

[2] CDM Executive Board, Approved Consolidated Methodology ACM 0002 Consolidated methodology for grid-connected electricity generation from renewable sources/Version 06, http://cdm.unfccc.int/UserManagement/FileStorage/CDMWF_AM_BW759ID58ST5YEEV6WUCN5744MN763

[3] *Forecast for the main macroeconomic indicators of BG in the period 2005-2008, August 2005, AIAF*

4.7%[4] in the end energy consumption (EEC) in the country. The strongest contribution for this growth belongs to the end users costs in the residential sector.

From the beginning of 2005 until July the inflation rate is 1.3%, while it was 3.9 % during the same period of the preceding year. The price dynamics by the end of 2005 was affected mainly by the foodstuff prices and by the international oil prices. In 2006 the crude oil prices continued rising. The liquid fuel prices in the country followed the world prices and since the beginning 2006 until July they increased by 26.2%. This caused an increase of the total inflation rate by 0.7%.

One of the preconditions for the achieved macroeconomic stability in the country, the Monetary Board, continued to operate steadily in 2006. The banking system is operating also successfully, and it assets increased by 39% in the past year.

During the period 2006-2008 the trend of positive economic development, which has been observed in the recent years, will be maintained in Bulgaria. The forecasted growth of the GDP in the period is about 5.5%.[5] The factors preconditioning the high economic growth are the large investments and the export's increase.

It is expected that investments will increase at a larger pace than the GDP and their portion is expected to reach 25.1 % of the GDP by 2008. Bulgaria's accession to the EU in the beginning of 2007 will have a positive impact on the investments dynamics, and in the last two years of the period their growth is expected to reach 13-14% per year. The largest contribution to the GDP growth in 2005 (5.2% by the end of the year) and in the other years in the considered period (between 5.4% and 5.6%) belongs to end consumption. This growth will be reached mainly by the real increase of the total revenue in the economy.

According to the forecasts the inflation rate in the period 2006-2008 will be about 3.5-4%. The expected accession of Bulgaria to the EU in the beginning of 2007 and its application for joining the European Monetary Union will result in lower inflation levels after 2008.

B.1.2 Energy sources used in Burgas Municipality

To define the energy sources used in Burgas Municipality is performed a marketing study for gasification of Burgas Municipality by the marketing specialists of Overgas Inc. AD, Gazosnabdyavane Burgas EAD and by external companies. In the course of the study the following have been performed:

- Detailed inspection of the users' combustion installations in the industrial and public and administrative sectors on the territory of Burgas Municipality in 2005. After conducting meetings with all industrial, public and administrative users and the larger trading outlets, the consumption of fuels and electricity has been identified, as well as the type of the installed equipment and the different users' perception of natural gas use;
- The market survey conducted by Market Test in 2005 provided information about the perception of the residential sector regarding the gasification process.

At present Burgas Municipality uses solid and liquid fuels, electricity, heat power, LPG and natural gas.

[4] *See pages 43/44, Long-term Energy Efficiency Program by 2015, Energy Efficiency Agency, 2005, http://www.doe.bg/download/dokumenti/NATIONAL_EE_PROGRAMME-last17.pdf*

[5] *Budget forecast for the period 2006-2008, Ministry of Finance, May 2005 http://www.minfin.government.bg/docs/MTFF%2006-08-Final-F-1.pdf*

Solid fuels
The delivery and distribution of solid fuels (wood, coal and briquettes) is carried out by a number of private companies that have warehousing facilities on the territory of Burgas and in its vicinity. These companies are mainly distributors of the production companies in this sector, which operate on the territory of the Republic of Bulgaria.

The solid fuels are used mainly by households. Other sectors use them only occasionally. The portion of the wood used in the residential sector is 10.7%. It is expected after the gasification the use of wood for heating in the residential sector to decrease slowly.

Coal and briquettes are supplied to Burgas Municipality by the following large coal-deposits mining companies: Bobov Dol Mine, Pernik Mine, Donbas, Kuzbas and Brikel.
The use of wood for heating constitutes 10.3%, and the use of LPG is 1.21% of the end energy consumption in the project area. There are no grounds to believe that the use of wood or LPG will increase considerably during the project period.

Liquid fuels
The delivery and distribution of liquid fuels (heavy fuel oil, gas oil, diesel oil and light ship fuel) is concentrated in the hands of private entrepreneurs at national and regional level. A main supplier is the oil refinery near Burgas, owned by Lukoil AD. A small part of the liquid fuels are delivered by direct import. The liquid fuels are used for technological needs (largest portion), heating, and the smallest portion used is for household hot water supply. In the area of Burgas Municipality the main supplier of fuels alongside with Neftochim Burgas is Toplivo EAD. Some other larger suppliers are Shell and OMV. In the residential sector the consumption of liquid fuels for heating is minimal because of their high price.

The recent years have marked a trend of decrease of the use of heavy fuel oil by the large users and switching to industrial gas oil due to its better physico-chemical properties and the smaller direct costs. For the calculation of the emissions current data obtained from the users by direct inquiries have been used.

Electricity
Electricity is used for heating, household hot water and technological needs in the industrial, public and administrative and residential sectors. Electricity has a large share in the energy balance of the end users in the residential sector. A major supplier in the region is Electrorazpredelenie Stara Zagora EAD.

Natural gas
The use of natural gas in Burgas started at the end of the 1970s with the gasification of Neftochim Burgas AD. Later on gas pipelines were constructed for the metallurgy facilities in Debelt and the Toplofikacia Burgas. At present on the territory of the municipality natural gas is supplied by Bulgargas EAD. Bulgargas EAD supplies natural gas to only three industrial users in the region, which are beyond the scope of the project.

The natural gas prices are regulated by the State Energy and Water Regulatory Commission (SEWRC). The heat and electric power for residential needs are subsidized. The prices of the other fuels alternative to natural gas (heavy fuel oil, gas oil, coal and wood) are determined by the market principle and are not regulated by the SEWRC.

The price of natural gas at the input of the gas transmission network is tied to the international prices of oil and liquid petroleum products and it is forecasted depending on their fluctuations. The natural gas

price at the output of the gas distribution network is tied to the investment costs incurred by the gas distribution companies.

The price per 1 KWh natural gas energy is 44% lower than the price per 1 KWh energy generated from 3.5% S heavy fuel oil, which is the main energy source replaced in the industrial sector. The natural gas price is almost three times lower compared to the industrial gas oil used in the public and administrative sector. For households, the natural gas price is 67% lower than the electricity price for residential use.

Information about the boilers used submitted by the Office for Supervision of the Installations and Facilities working under high pressure and generating steam is shown in *Annex 2*.

The results of the marketing study conducted by Overgas Inc. AD on the territory of the license of Gazosnabdyavane Burgas EAD show that the structure of energy sources in the project area in 2005 was as follows: 17.71% of solid fuels, 15.75% of liquid fuels and 66.54% of electricity. The energy consumption and the structure of energy sources in the industrial and public and administrative sectors have been identified after individual inquiries to each user.

Energy source	***Industrial sector***		***Public and administrative sector***		***Residential sector***		***Total***	
	ton	***TJ***	***ton***	***TJ***	***ton***	***TJ***	***ton***	***TJ***
Heavy fuel oil	7 000	281	300	12	0	0	7 300	293
Gas oil	2 000	84	5 000	210	230	10	7 230	303
Brown coal	500	6	500	6	400	5	1 400	16
Black and anthracite coal	0	0	0	0	11 000	281	11 000	281
Wood	0	0	0	0	43 000	430	43 000	430
LPG	200	9	350	17	500	24	1 050	50
Electricity	110 GWh	396	98 GWh	353	550 GWh	1 980	758 GWh	2 729

Table 2: Energy consumption of the end users in the base year 2005

In the residential sector a part of the households were interviewed covering the area of the Central city part, Bratia Miladinovi, Vazrajdane and Meden Rudnik. In the area covered by the license most of the homes are flats, where no solid fuels may be conveniently used. The electricity is the main energy source used for heating and hot water in these buildings.

B.1.3 Forecasts for the end energy consumption without the project implementation

The forecasts for the end energy consumption (EEC) by 2017 in Burgas Municipality have been prepared on the basis of expert evaluation made by the experts in Strategic marketing and business planning Department, Overgas Inc. AD after analyz the EEC forecasts in the National Long-term Energy Efficiency Program[6] by 2015 of the Energy Efficiency Agency, the Short-term forecast of AEAF for Bulgaria's economy[7]; the Energy strategy of Bulgaria[8], data from the Ministry of Economy and Energy

[6] *National long term energy efficiency programme till the year 2015, 2005 State energy efficiency agency*
[7] *Short-term Forecast for Bulgaria's Economy, October 2005, AEAF*

about the economic situation of the Southeastern Planning Region.[9]; the National plan for economic development[10], the Regional plan for development of South-east planning region[11]; the Regional strategy for development of Burgas municipality[12].

Burgas is characterized by high economic and demographic development factors and a high consumption potential respectively. The economy of Burgas District is well represented at national level. Having forecasted growth of 4.7% for the end energy consumption (it. B.1.1) in the country we assume a conservative annual growth of **2.52%** for Burgas Municipality in the period 2006-2017**.**

As a starting point for the **forecasts for the energy consumption without the project implementation** are used the data for the energy consumption during the base year 2005 (*Table 2).* The change in the energy consumption by energy sources for the period 2006-2017 is calculated at a permanent growth of the end energy consumption of **2.52%** and maintaining the structure of the used energy sources. The growth in the end energy consumption by sectors is as follows: **2.2%** in the industrial sector, **4.9%** in the public and administrative sector and **1.8%** in the residential sector.

The change in the energy consumption by energy sources without the project implementation is shown in *Table 3.*

Energy source	***2005***	***2006***	***2007***	***2008***	***2009***	***2010***	***2011***	***2012***	***2013***	***2014***	***2015***	***2016***	***2017***
Heavy fuel oil	293	300	307	314	321	329	337	344	353	361	369	378	387
Gas oil	303	315	328	341	355	370	385	401	418	435	454	473	493
Brown coal	16	16	17	17	18	18	19	20	20	21	22	22	23
Black and anthracite coal	280	286	291	296	301	307	312	318	324	329	335	341	347
Wood	430	438	445	454	462	470	479	487	496	505	514	523	533
LPG	50	51	53	54	56	58	59	61	63	65	67	69	71
Electricity	2 729	2 791	2 854	2 919	2 986	3 054	3 125	3 198	3 272	3 349	3 428	3 510	3 593
Total	**4 101**	**4 197**	**4 295**	**4 396**	**4 499**	**4 606**	**4 716**	**4 829**	**4 946**	**5 065**	**5 189**	**5 316**	**5 447**

Table 3: Energy consumption by energy sources without project implementation, TJ

B.1.4. Calculation of the total emissions without project implementation - Baseline

The baseline emissions ***(BEy)*** during the year ***y*** include the emissions of carbon dioxide (CO_2) released from the burning of solid and liquid fuels in the combustion installations in the industrial, public and administrative and residential sectors, and the emissions from electricity, that could be replaced with natural gas. They are calculated as a sum of the emissions of each fuel ***(i)*** burned in the combustion installations and the emissions from the generation of the electricity being replaced without the project implementation.

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[8] *Energy strategy of Bulgaria, 2002, Ministry of Energy and energy recourses; State Energy Efficiency Agency*
[9] *http://www.mi.government.bg/ind/regpol/region.html?br_id=149*
[10] *National plan for economic development. Mart 2003 Ministry of economy. As part of it "Economic situation of South-East planning region.*
[11] *Regional plan for development of South-east planning region 2007-2013, June 2005 Ministry of regional development and public works*
[12] *Regional strategy for development of Burgas municipality 2005-2015, Burgas municipality*

The emissions released from the combustion of each fuel are calculated from the quantity of used fuel in tons, the low heating value (LHV)[13] of the fuel and the CO_2 emission factor of the fuel. The baseline emissions are calculated by sectors because of the different energy efficiency of the combustion installations and the different emission factors for one and the same fuel.

The greenhosue gases emission factors of liquid and gaseous fuels $\boldsymbol{EF_{FF,CO2,i}}$ are calculated by multiplying the carbon content in the fuel [tC/TJ] by a Fraction of carbon oxidised and by the ratio of the CO_2 mass to carbon mass. The Fraction of carbon oxidised is 0.99 for liquid fuels and 0.995 for gaseous fuels. The carbon content is taken from the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories[14].

$$\boldsymbol{(1)\ EF_{FF,CO2,i} = C_C * \varepsilon * 44/12\ ,}$$

Where:

$\boldsymbol{C_C}$ Carbon content of liquid and gaseous fuels from the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories in t/TJ;

$\boldsymbol{\varepsilon}$ Fraction of carbon oxidised according to Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories - 0.99 for liquid and 0.995 for gaseous fuels.

Thus calculated emission factors coincide with those used in the Bulgarian National Greenhouse Gas Inventory Report.[15] The emission factors of solid fuels are taken from the same document.

The emissions from electricity, replaced by natural gas, are calculated using the emission factor defined in "Concise Baseline Study of Bulgarian Electric Power System (EPS). CO_2 Baseline Emission Factor of EPS" (*Annex 2)*.

$$\boldsymbol{(2)\ EE_y = E_{R\,y} * EF_{y,ES} * 1000,}$$

Where:

$\boldsymbol{EE_y}$ Emissions from the electricity generation for the year $\boldsymbol{y}$ that could be substituted for natural gas in tCO_2e;

$\boldsymbol{E_{R\,y}}$ Quantity of electricity replaced by natural gas in a respective sector without project implementation during the year $\boldsymbol{y}$ in GWh;

$\boldsymbol{EF_{y,ES}}$ CO_2 Baseline Emission Factor of the replaced electricity in tCO_2e/MWh.

The baseline emissions **(*BEy*)** are calculated as a sum of the emissions in the three sectors using the formula:

$$\boldsymbol{(3) BE_y = BE_{,.ind} + BE_{y,com} + BE_{y,rez},}$$

The baseline emissions $\boldsymbol{(BE_{,y,sec})}$ for each sector are calculated using the formula:

$$\boldsymbol{(4)\ BE_{y,sec} = \sum_i FF_{baseline\ i\ y}\ LHV_{FF,i}.\ EF_{FF,CO2,i} + EE_{y\ sec},}$$

Where:

$\boldsymbol{BE_{y.sec}}$ Baseline emissions for a respective sector during the year $\boldsymbol{y}$ in tCO_2e;

$\boldsymbol{FF_{baseline,i,y}}$ Quantity of solid and liquid fuel $\boldsymbol{i}$ that would be combusted in a respective sector without project implementation during the year $\boldsymbol{y}$ in tons;

$\boldsymbol{LHV_{FF,i}}$ Average low heating value of the solid and liquid fuel that would be combusted in a respective sector without project implementation in TJ/t;

$\boldsymbol{EF_{FF,CO2,i}}$ Carbon dioxide emission factor of every type solid and liquid fuel $\boldsymbol{i}$ that would be combusted in a respective sector without project implementation in tCO_2/TJ.

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[13] *LHV is equivalent to NCV(Net caloric value)*

[14] *http://www.ipcc-nggip.iges.or.jp/public/gl/invs1.htm*

[15] *http://nfp-bg.eionet.eu.int/ncesd/bul/ncesd/bul/UNFCCC/2003/index.html*

$EE_{y\,sec}$ Emissions from the electricity generation for year ***y***, replaced by natural gas in tCO_2e in a respective sector.

The quantity of the annual GHG emissions released in the project area without implementation of gasification is shown in *Table 4*.

Year	*Industrial sector*	*Public and administrative sector*	*Residential sector*	*Total*
2005	132 435	110 165	549 073	791 673
2006	144 812	124 217	606 088	875 117
2007	147 997	130 304	616 998	895 299
2008	151 253	136 689	628 104	916 045
2009	154 581	143 386	639 409	937 377
2010	157 982	150 412	650 919	959 313
2011	161 457	157 783	662 635	981 875
2012	165 009	165 514	674 563	1 005 086
2013	168 640	173 624	686 705	1 028 968
2014	172 350	182 132	699 066	1 053 547
2015	176 141	191 056	711 649	1 078 846
2016	180 016	200 418	724 458	1 104 893
2017	183 977	210 238	737 499	1 131 714

Table 4: Greenhouse gas emissions without project implementation - baseline, tCO_2e

B.2. Description of how the anthropogenic emissions of greenhouse gases by sources are reduced below those that would have occurred in the absence of the JI project:

The project "Reduction of greenhouse gases by gasification of Burgas Municipality" is additional to any scenario that would otherwise occur. The most probable and the only alternative without project implementation is no fuel switch, i.e. the current practice of using electricity, heavy fuel oil, wood, industrial gas oil and coal as energy sources to continue.

The development of the gasification process and the natural gas market depend on the following:

- The country's economic development;
- The end energy consumption;
- The purchasing capacity of the population;
- The competitiveness of natural gas towards the other fuels.

The Project includes the natural gas supply and its use by the end consumers from the industrial, public and administrative, and residential sectors. This project replaces the solid and liquid fuels by natural gas and creates conditions for reducing the fuel consumption by introducing energy efficient technologies after restructuring the energy system equipment to work on natural gas.

The end users in the three consumer sectors are the main fuels consumers. The substitution of the used solid and liquid fuels, which have a high carbon dioxide emission factor, for natural gas has the greatest effect on the reductions of GHG emissions. These emissions are directly released on-site the project, which covers the territory of Burgas municipality.

Fuel	*Industrial sector*	*Public and administrative sector*	*Residential sector*
Heavy fuel oil	76.6	76.6	76.6
Gas oil	73.3	73.3	73.3
Brown coal	95.1	95.6	95.6
Wood	0.0	0.0	0.0
Black and anthracite coal	101.4	101.4	101.3
Briquettes	0.0	0.0	95.6
LPG	62.44	62.44	62.44
Natural gas	55.82	55.82	55.82

Table 5: Emission factors of fuels, ton CO_2/TJ[16]

Wide electricity consumption by households for heating, hot water and cooking is typical for Bulgaria. Replacing electricity with natural gas, due to its high carbon dioxide emission factor, substantially reduces the off-site greenhouse gas emissions released during electricity generation.

Leakages occur during storage and transportation of solid and liquid fuels, as well as during low-voltage energy distribution. The leakages during storage and transportation of solid and liquid fuels are not included in the baseline scenarios and monitoring plan. They are minimal and are not included in the calculation of the emissions.

According to the ACM0002 methodology, the baseline emission factors $\boldsymbol{EF_{e,y}}$ are calculated as Combined Margin emission factors – $\boldsymbol{EF_{CM}}$, which are a combination of an Operating Margin emission factor – $\boldsymbol{EF_{OM}}$ and a Build Margin emission factor $\boldsymbol{EF_{BM}}$.

The Operating Margin emission factor is calculated as the average value of $\boldsymbol{EF_{OM}}$ for the period 2003 - 2005. For the Build Margin emission factor has been taken the value of $\boldsymbol{EF_{BM}}$ for 2005 (the last year for which data are available). The CO_2 emission factor for the Bulgarian electricity system $\boldsymbol{EF_{y,EG}}$ is calculated as a Combined Margin emission factor with ratio of $\boldsymbol{EF_{OM}}$ to $\boldsymbol{EF_{BM}}$ 50:50.

Emission factor	*g CO_2 / kWh*	*tCO_2 / TJ*
EF_{OM} 2003	1017	282.5
EF_{OM} 2004	1044	290.0
EF_{OM} 2005	841	233.6
EF_{BM} 2005	842	233.9
$EF_{y,EG}$	904	251.1
$EF_{y,ES}$	**1026**	**285.0**

Table 6: Emission factors of electricity replaced by natural gas

[16] *Bulgaria's National Greenhouse Gas Inventory Report*
http://nfp-bg.eionet.eu.int/ncesd/eng/UNFCCC/home.html

The Combined Margin emission factor $EF_{y,ES}$ of the replaced by natural gas electricity includes the technological losses in the transportation and distribution networks.

To calculate the greenhouse gas emissions from the electricity generation, the average value of the emission factors for the three-year period 2003 – 2005 is used. Thus calculated, the emission factor is fixed for the entire creditting period and it will not to be recalculated during the monitoring of the project.

The combustion installations in the three consumer sectors are of different types and with different energy efficiency. The industrial and the public sectors use boilers burning mostly liquid fuels – heavy fuel oil and gas oil. The residential and a small part of the public sector use low-efficiency fire-grate boilers. Replacing them with contemporary gas boilers will result in a considerable reduction of fuel consumption and GHG emissions.

An important effect of gasification is the creation of favorable conditions for energy system optimization and the use of cogeneration, which further reduces the end energy consumption and consequently reduces GHG emissions.

Operational energy efficiency factors			
Energy source	***Industrial sector***	***Public and administrative sector***	***Residential sector***
Heavy fuel oil	0.80	0.80	not used
Gas-oil	0.88	0.88	0.80
Brown coal	0.70	0.70	0.65
Wood	0.65	0.65	0.65
Black and anthracite coal	not used	not used	0.65
Briquettes	not used	not used	0.65
Liquefied Petroleum Gasses	0.90	0.90	0.89
Electricity	0.98	0.98	0.98
Natural gas	0.90	0.90	0.90

Table 7: Operational energy efficiency factors of the combustion installations by sectors and energy sources

The use of liquid fuels, and heavy fuel oil in particular, requires warming-up of reservoirs and pipelines during storage and transportation. The gasification leads to reduction of energy costs for storage and transportation of liquid fuels and respectively to reduction of fuel consumption and greenhouse gas emissions.

B.2.1. Additionality

Only some of the large industrial enterprises in Bulgaria use natural gas. The construction of GDN in the cities has started in the recent years and it is accompanied by difficulties due to lack of knowledge of natural gas usage, the need of large investments for GDN construction and the low purchasing capacity of the population. Significant economic, social and technological barriers have prevented up to now the large-scale switch to natural gas in the Burgas municipality.

Natural gas has been introduced near Burgas at the end of 1970s but for this period of 30 years only one plant switched to natural gas - the district heating plant Toplofikacia Burgas EAD. The construction of

GDN and the delivery of natural gas to the residential sectors demand larger investments with longer pay-back period than the other sectors and need additional support. The revenues from the sale of emission reduction units will assist in providing for the necessary financing and will give an opportunity for starting the project and introducing natural gas in the residential sector.

The end energy consumption of the households in Bulgaria is characterized by a high share of the used electricity (34%-38%) by comparison with this indicator for Europe (10%-12%)[17]. Due to the high value of the emission factor of the replaced electricity and the low energy efficiency of the combustion installations used by the households the highest reduction of greenhouse gas emissions is being observed in the residential sector (about 55 000 tCO_2e reduction in 2012). This reduction results from the gasification in 2012. In 2012 the 61% of the emission reductions are due to gasification in the residential sector.

The revenues from the sale of ERUs will act as a special kind of catalyst for the fuel switch. The project "Reduction of greenhouse gases by gasification of Burgas Municipality" is not business as usual for the territory of the project, which underlines its additionality without any doubt.

- ***Technical barriers***

The use of natural gas is new to nearly all future end-users on the territory of licenses of Gazosnabdyavane Burgas EAD. Overgas Inc. AD has to invest in training and education of the installers. It is indispensable that an intensive public campaign familiarize the end users with the safe and efficient use of natural gas.

The technical means for reconstruction of the combustion installations are not available to the installers and end users. A program and measures for mass supply of various and state-of-art technical options are planned under this project.

The skills to install natural gas pipelines, flue gas chimneys and appliances are in quite initial development stage. In this project, large-scale training and education of the installers has to overcome this barrier. Therefore, it is necessary to develop and implement specialized training and retraining programs.

The technology is new to the territory of Burgas project and needs to be adapted to the typical Burgas situation, for example, for the use of natural gas in the existing large and compact apartment buildings. The installation of a completely new network in the densely populated project area requires an adaptation of existing pipe laying technologies.

The use of natural gas is associated with widely spread safety risks, not only by the potential end users, but also by the local authorities. In this project an intensive public relation campaign is necessary to overcome this barrier.

- ***Investment barriers***

The launching of a wide scale infrastructure project such as the Gasification Project of Burgas municipality requires huge investments.

The replacement of energy sources requires the purchasing of natural gas equipment by the end users. Part of the end users should also adjust their installations to natural gas or build entirely new

[17] *National long term energy efficiency programme till the year 2015, 2005 State energy efficiency agency*

installations, ensure proper ventilation and possibility for implementation of operating requirements to guarantee the safe use of natural gas according to existing regulations.

- ***Financial barriers***

Financing of infrastructural projects by private banks in Bulgaria is troublesome by the perception of high risks. Having the validated project, and the additional financial revenues under the Joint Implementation Mechanism, the private banks will be less reluctant in taking their share in financing the project. Guaranteed revenues from emission reduction sales will facilitate the arrangement of bank loans.

- ***Total development barriers***

The current infrastructure is constructed to use solid and liquid fuels. The potential users are familiar with all aspects of the use of solid and liquid fuels: prices, availability, appliances, risks and precautions. The awareness of the advantages of the use of natural gas is still in initial stage for most of the future consumers.

The end users consider the use of solid and liquid fuels as standard practice. The use of natural gas is still perceived by most of the future users as new and risky. For nearly all end users, the utilization of natural gas will be "a first of a kind" experience.

- ***Legal barriers***

The legislation is important to ensure the safe energy use. The general use of natural gas is new for a large group of consumers in Bulgaria. New regulations must be introduced, accepted, understood by the officials. Essential modifications of building regulations, for example, require long time to be designed and incorporated in the daily practice. All procedures for installation permits are slow and complicated.

- ***Institutional barriers***

Apart from JI project revenues, there are no subsidies available. The Bulgarian Government has a policy to support only energy efficiency and renewable energy sources projects. This support does not include any financial incentives: neither for Overgas Inc. AD, nor for the potential end users.

The Second National Action Plan on Climate Change for the period 2005 – 2008 reflects the national policies concerning the measures for support of emission reductions projects and there is stated that the flexible Kyoto mechanisms could be used for gasification projects financing.

B.3. Description of how the definition of the project boundary is applied to the project:

B.3.1. Direct on-site emissions

Direct on-site greenhouse gas emissions of the project are:

- Emissions released by the end-users' combustion installations;
- Emissions released due to leakages during transportation and delivery of fuels.

The reduction of direct on-site emissions will be achieved by:

- Fuel switch at the end-users;
- Optimization of the combustion process and energy systems;
- Elimination of leakages during fuels' storage, transportation and delivery.

The emissions from leakages of natural gas from the gas distribution networks have been identified by applying the emission factors of 2006 IPCC Guidance for National Greenhouse Gas Inventories of the UNFCCC and on the basis of input data from the Operation of Gas Distribution Networks and Natural Gas Sales Departments of Overgas Inc. AD.

Overgas Inc. AD will use up-to-date methods and materials in the construction of gas distribution networks. This type of gas distribution networks does not have dismountable joints and the leakages are insignificant. Emissions caused by the leakages of natural gas in tCO_2e from the gas distribution networks have been excluded from the calculations.

B.3.2. Direct off-site emissions

Direct off-site emissions are caused by the generation of the electricity replaced by natural gas including cogeneration sources on site. Bulgaria has the highest emission factor per GHG per 1 kWh electricity among Eastern European countries due to the use of lignite coals by the thermal power plants. For calculation of the emission reductions as a result of switching from electricity to natural gas a CO_2 emission factor of the replaced electricity, defined in "Concise Baseline Study of Bulgarian Electric Power System (EPS). CO_2 Baseline Emission Factor of EPS" (Annex 2) is used. In the calculation, the losses during the transportation and distribution of the replaced electricity are taken into account.

B.3.3. Indirect on-site and off-site emissions (Leakages)

The indirect on-site and off-site emissions may be characterized as follows:

- Emissions during the production and processing of the fuels;
- Emissions during the production of metals, transport vehicles and tanks for transportation and storage of fuels;
- Emissions during the transportation and disposal of fuel wastes.

In the project, only the emissions from the underground mining and the post-mining activities of the replaced coal are considered.

B.3.4. Project boundaries

The project boundaries include on-site emissions of the combustion installations of the industrial, public and administrative, and residential sectors in Burgas municipality, excluding HP Burgas EAD and Kronospan Bulgaria EOOD. The implementation of the project involves the replacement of large amount of electricity directly by natural gas or by cogeneration. The project boundaries also cover the generation, the transportation and the distribution of this electricity.

	Source	*Gas*	*Included*	*Explanation*
Baseline - activity without project implementation	Burning of solid and liquid fuels	CO_2	Yes	Main emission source
		CH_4	No	Small emission source
		N_2O	No	Small emission source
Project activity	Burning of natural gas	CO_2	Yes	Main emission source
		CH_4	No	Small emission source
		N_2O	No	Small emission source
Project activity	Generation, transportation and distribution of electricity, that will be replaced	CO_2	Yes	Main emission source

Table 8: Sources of on-site and off-site emissions

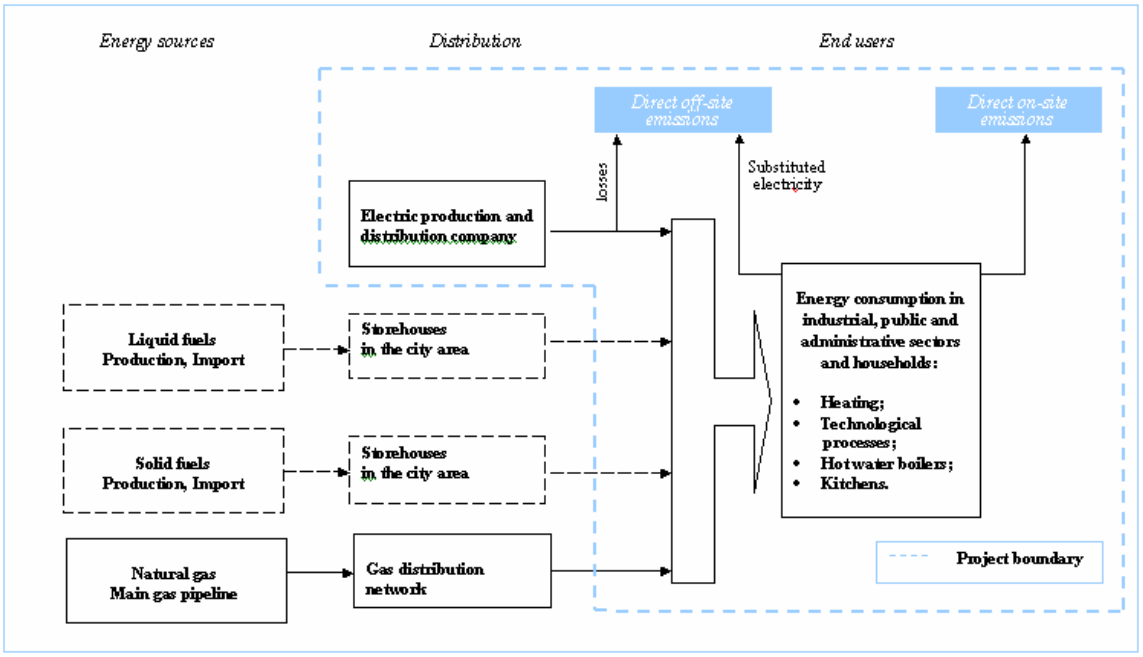

Fig.2 : Block-scheme of fuels delivery after gasification and project boundaries

B.4. Further baseline information, including the date of baseline setting and the name(s) of the person(s)/entity(ies) setting the baseline:

Date of baseline setting: April 2005
Name of the entity setting the baseline: Overgas Inc. AD in "Marketing report on the gasification and natural gas distribution in Burgas"

SECTION C. Duration of the project / crediting period

C.1. Starting date of the project:

2006

C.2. Expected operational lifetime of the project:

The expected operational lifetime of the project is 35 years, according to the licenses for distribution of natural gas given to Gazosnabdyavane Burgas EAD by SEWRC.

The permanent growth of the gas distribution networks is an opportunity for connecting new consumers after 2017 – enterprises, municipal sites and households, and, in return, the need of expansion of these networks.

C.3. Length of the crediting period:

In the period until 1st of January 2008
2008-2012

2013-2017

SECTION D. Monitoring plan

D.1. Description of monitoring plan chosen:

Main principles

The total annual natural gas consumption of the end users by sectors will be used as an indicator to control and determine the greenhouse gas emissions with project implementation. This approach has been used due to the following:

- All currently used fuels are replaced only by natural gas;
- In the absence of this project end users would use fuels different from natural gas.

The reported natural gas sales under this project in the industrial and public and administrative sectors include the users that have signed sales contracts with a clause for adding their ERUs to the total amount of ERs under the project "Reduction of greenhouse gases by gasification of Burgas Municipality.

The fuel switch emission reduction factor for each sector calculated according to the formula (19) is used to convert natural gas sales by sectors in emission reduction units. The fuel switch emission reduction factors include the fuel switch effect and reduced energy consumption due to the increase of the efficiency of the combustion installations.

For the monitoring of the baseline emissions of the project, as an indicator is used the reported statistical data on regional or national level for the end energy consumption growth and for the change in the fuel mix. The end energy consumption fuel mix is recalculated for each reported year with the data for the fuel mix change and the EEC growth for the last two years before the reported year.

In case of a change in the calorific value of the delivered natural gas, a recalculation of natural gas quantity will be done taking into account the calorific value used for the calculations in the PDD.

The leakages have to be calculated and their immateriality has to be proved annually.

The project monitoring includes the following stages:

- Monitoring of the project emissions and of the generated Emission Reduction Units (ERU);
- Monitoring of the baseline;
- Monitoring of the leakages.

D.1.1. Option 1 – Monitoring of the emissions in the project scenario and the baseline scenario:

Monitoring of the project scenario emissions

The project emission monitoring activities are performed in the following sequence:

- Measuring the amounts of natural gas sold by sectors;
- Calculation of the Fuel Switch Emission Reduction Factor (FSERF) with the corrected baseline;
- Calculation of the generated emission reductions.

Measurement of natural gas quantities sold by sectors

According to the main principles of the monitoring plan, the main indicator for the ERU quantity is the natural gas sales. Natural gas quantity should be measured in cubic meters at standard conditions. "Cubic meter at standard conditions" means the quantity of natural gas in a volume of one cubic meter at a temperature of 293.15 K and absolute pressure 0.101325 MPa.

The conditions and the order for reporting of the delivered by each Gas Distribution Company (GDC) quantities of natural gas is regulated by the ***Rules for working with the users*** and ***General terms and conditions for selling natural gas to users for household needs***. According to the rules for working with the users, to transform the measured quantities of natural gas into standard conditions two methods are applied:

- Use of special devices called volume correctors;
- Use of a fixed factor, defined depending on the meteorological characteristics of the respective geographic area.

The transformation of the measured natural gas quantities into standard conditions for the commercial users is done using volume correctors in the measuring devices. The measurement of the quantities of natural gas delivered to the residential and "small" commercial users (with 100 mbar pressure and with maximum hourly consumption of less than 25 m^3/h) is done with a fixed factor, defined in the Rules for working with the users and in *Annex 3 to PDD.*

Natural gas sales data, as well as the data for the number of new users are collected in Overgas Inc. monthly as per ***Procedure П 8.1-011 for Control of Natural Gas Retail Sales*** of the Quality Management System in accordance with the ***General terms and conditions for selling natural gas*** and the ***Rules for working with the users***. In this procedure, the way and deadlines for receipt of that information are described in details. The received information is further checked by an expert of „Contracts for Delivery, Prices and Conditions" Department, then data are cross-checked with the Gas Distribution Company Information management system, then it is summarized and systematized. After that the processed information is submitted to „Control, Reporting and Analysis" Department where it is also checked and possible mistakes are removed. That information serves as a basis for the elaboration of all monthly and annual reports submitted to the company management and the state regulation bodies.

D.1.1.1. Data to be collected in order to monitor emissions from the project, and how these data will be archived:								
ID number	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/paper)	Comment
1.	Sales of natural gas in industrial sector $FF_{project, NG1,y}$	Monthly statements and annual statement for natural gas deliveries to the industrial consumers by Gazosnabdyavane Burgas EAD	sm^3	m	Monthly and annual	Annual sales	Electronic/paper	
2.	Sales of natural gas in public and administrative sector $FF_{project, NG2,y}$	Monthlystatements and annual statement for natural gas deliveries to the public and administrative consumers by Gazosnabdyavane Burgas EAD	sm^3	m	Monthly and annual	Annual sales	Electronic/paper	
3.	Sales of natural gas in residential sector $FF_{project, NG3,y}$	Reference by Gazosnabdyavane Burgas EAD for sales by invoices	sm^3	k	Monthly and annual	Annual sales	Electronic/paper	
4.	Bought amount of natural gas from Bulgargas AD	Annual statement for delivery between Gazosnabdyavane Burgas EAD and Bulgargas EAD	sm^3	m	Monthly and annual	Annual delivery	Electronic/paper	

$FF_{project\ NG\ y,z}$ Quantity of natural gas that would be combusted in a respective sector z with the project implementation during the year y in 1000 sm^3.

D.1.1.2. Description of formulae used to estimate project emissions (for each gas, source etc.; emissions in units of CO_2 equivalent):

The project emissions (***PEy***) during the year ***y*** include the carbon dioxide (CO_2) emissions released during the burning of solid and liquid fuels and natural gas in the combustion installations in the industrial, public and administrative and residential sectors and the emissions from electricity, which may be replaced by natural gas. They are calculated as the sum of the emissions of each fuel (***i***), burned in the combustion installations and the emissions from the generation of the electricity replaced during the project implementation.

The assessment of the emissions from the project is done in the following sequence:

1. Determination of the volume of fuels replaced by natural gas by types of fuel and by sectors;
2. Calculation of the equivalent quantity of natural gas for each type of replaced fuel;
3. Calculation of the quantities of fuels by sectors with the project implementation;
4. Calculation of the project emissions ***PEy***.

Determination of the volume of the fuels replaced by natural gas, by types of fuel and by sectors

The quantity of the solid and liquid fuels being replaced by natural gas is determined on the basis of the extent of introduction of the natural gas in the respective sectors depending on the stages of the project.

Calculation of the equivalent quantity of natural gas for each type of replaced fuel

$$(5)\ FF_{NG,y} = FF_{fuel\ switch,i,y} * K_i,$$

Where:

$FF_{NG,y}$	Quantity of natural gas that would be combusted with the project implementation in a respective sector after replacing the fuel ***i*** during the year ***y*** in 1000 sm³;
$FF_{fuel\ switch,i,y}$	Quantity of solid or liquid fuel ***i*** that would be replaced with the project implementation in a respective sector during the year ***y*** in tons;
K_i	Factor for conversion of fuel ***i*** into natural gas in 1000 sm^3/t.

For the calculation of K_i *Operation efficiency factors by sectors and fuels* are used (*Presented in item B.2. of PDD, Table 9)*

For the calculation of the quantities of natural gas equivalent to the replaced fuels the following formula is used:

$$(6)\ K_i = LHV_{FF,i} \cdot \varepsilon_{baseline,i} / LHV_{FF_{NG},} \cdot \varepsilon_{project,NG}$$

where:

K_i	Factors for conversion of the energy sources into natural gas in 1000 sm^3/t;
$LHV_{FF,i}$	Average low heating value of the solid and liquid fuel ***i*** that will be replaced in a respective sector with the project implementation in TJ/t;
$LHV_{FF,NG,}$	Average low heating value of the natural gas in TJ/1000 sm^3;
$\varepsilon_{project,NG}$	Energy efficiency of the combustion installation working on natural gas;
$\varepsilon_{baseline,i}$	Energy efficiency of the combustion installation working on solid or liquid fuel ***i.***

Calculation of the quantities of fuels by sectors with the project implementation

The quantities of fuels by sectors with the project implementation are calculated as difference between the quantities of fuels without the project implementation and the volume of replaced fuels.

Calculation of the project emissions

The project emissions PE_y released by the combustion installations of the end users with the project implementation are calculated as the sum of the emissions in the industrial ($PE_{y.ind}$), the public and administrative ($PE_{y.com}$) and the residential ($PE_{y.res}$) sectors using the formula:

$$(7)\ PE_y = PE_{y.ind} + PE_{y.com} + PE_{y.res}$$

The project emissions ($PE_{y,sec}$) for each sector are calculated using the formula:

$$(8)\ PE_{y.sec} = \sum_i FF_{project,i\,y}\, LHV_{FF.i} EF_{FF,CO2,i} + EE_y + FF_{NG\,y}\, LHV_{FF_{NG},y}\, EF_{FF_{NG},y,CO2}$$

Where:

$PE_{y,sec}$	Project emissions for a respective sector during the year y in tCO_{2e};
$FF_{project,i,y}$	Quantity fuel i that would be combusted in a respective sector with the project implementation during the year y in tons;
EE_y	Emissions from electricity generation for the year y that could be substitute for natural gas in tCO_{2e};
$FF_{NG\,y}$	Quantity of natural gas combusted in a respective sector with the implementation of the project during the year y in 1000 sm^3;
$LHV_{FF,i}$	Average low heating value of a fuel i that would be combusted in a respective sector with the project implementation in the year y in TJ/t;
$EF_{FF_{NG},y,,CO2,}$	Carbon dioxide emission factor of natural gas that would be combusted in a respective sector with the project implementation during the year y in $tCO_2/1000\ sm^3$;
$EF_{FFi,CO2,i}$	Carbon dioxide emission factor for each type solid and liquid fuel i that would be combusted in a respective sector with the project implementation during the year y in tCO_2/TJ.

Monitoring of the baseline emissions

The baseline monitoring activities are performed in the following sequence:

- Considering the End Energy Consumption (EEC) by fuels and sectors for the two years preceding the reported year on national or regional level;
- Calculation of the fuel share changes in the end energy consumption by sectors for the two years preceding the reported year;
- Correction of the fuel shares in the end energy consumption by sectors on the project territory in accordance with the data for the fuel mix changes;
- Calculation of the EEC growth for the last two years preceding the reported year and correction of the baseline fuel mix;
- Calculation of the baseline emissions.

D.1.1.3. Relevant data necessary for determining the baseline of anthropogenic emissions of greenhouse gases by sources within the project boundary, and how such data will be collected and archived:								
ID number	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
1.	*Final* energy consumption of residual** fuel oil in the industry*	*Energy: yearly statistics, Eurostat or Energy balance sheets, Eurostat or Statistical Yearbook, National Statistical Institute or Marketing*	*1000 toe, TJ*	*c*	*annually*		*Electronic, paper*	*for the 2 years preceding the reported year*
2.	*Final energy consumption of gas oil in the industry*		*1000 toe, TJ*	*c*	*annually*		*Electronic, paper*	
3.	*Final energy consumption of brown coal briquettes in the industry*		*1000 toe, TJ*	*c*	*annually*		*Electronic, paper*	
4.	*Final energy consumption of coal in the industry*		*1000 toe, TJ*	*c*	*annually*		*Electronic, paper*	

D.1.1.3. Relevant data necessary for determining the baseline of anthropogenic emissions of greenhouse gases by sources within the project boundary, and how such data will be collected and archived:								
ID number	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
5.	*Final energy consumption of biomass in the industry*	*report for the energy consumption of the end users*	*1000 toe, TJ*	*c*	*annually*		*Electronic, paper*	
6.	*Final energy consumption of LPG in the industry*	*Energy: yearly statistics, Eurostat or Energy balance sheets, Eurostat or Statistical Yearbook, National Statistical Institute or Marketing report for the energy consumption of the end users*	*1000 toe, TJ*	*c*	*annually*		*Electronic, paper*	
7.	*Final energy consumption of electricity in the industry*		*1000 toe, TJ*	*c*	*annually*		*Electronic, paper*	
8.	*Final energy consumption of residual fuel oil in the public and administrative sector*		*1000 toe, TJ*	*c*	*annually*		*Electronic, paper*	
9.	*Final energy consumption of gas oil in the public and administrative sector*		*1000 toe, TJ*	*c*	*annually*		*Electronic, paper*	

D.1.1.3. Relevant data necessary for determining the baseline of anthropogenic emissions of greenhouse gases by sources within the project boundary, and how such data will be collected and archived:								
ID number	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
10.	*Final energy consumption of brown coal briquettes in the public and administrative sector*	*Energy: yearly statistics, Eurostat or Energy balance sheets, Eurostat or Statistical Yearbook, National Statistical Institute or Marketing report for the energy consumption of the end users*	*1000 toe, TJ*	*c*	*annually*		*Electronic, paper*	
11.	*Final energy consumption of coal in the public and administrative sector*		*1000 toe, TJ*	*c*	*annually*		*Electronic, paper*	
12.	*Final energy consumption of biomass in the public and administrative sector*		*1000 toe, TJ*	*c*	*annually*		*Electronic, paper*	
13.	*Final energy consumption of LPG in the public and administrative sector*		*1000 toe, TJ*	*c*	*annually*		*Electronic, paper*	
14.	*Final energy consumption of electricity in the public and administrative sector*		*1000 toe, TJ*	*c*	*annually*		*Electronic, paper*	
15.	*Final energy consumption of residual fuel oil in the residential sector*		*1000 toe, TJ*	*c*	*annually*		*Electronic, paper*	
16.	*Final energy consumption of gas oil in the residential sector*		*1000 toe, TJ*	*c*	*annually*		*Electronic, paper*	
17.	*Final energy consumption of brown coal briquettes in the residential sector*		*1000 toe, TJ*	*c*	*annually*		*Electronic, paper*	

D.1.1.3. Relevant data necessary for determining the baseline of anthropogenic emissions of greenhouse gases by sources within the project boundary, and how such data will be collected and archived:								
ID number	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
18.	*Final energy consumption of coal in the residential sector*		*1000 toe, TJ*	*c*	*annually*		*Electronic, paper*	
19.	*Final energy consumption of biomass in the residential sector*		*1000 toe, TJ*	*c*	*annually*		*Electronic, paper*	
20.	*Final energy consumption of LPG in the residential sector*		*1000 toe, TJ*	*c*	*annually*		*Electronic, paper*	
21.	*Final energy consumption of electricity in the residential sector*		*1000 toe, TJ*	*c*	*annually*		*Electronic, paper*	

***Final energy consumption = end energy consumption**
****Residual fuel oil = heavy fuel oil**

D.1.1.4. Description of formulae used to estimate baseline emissions (for each gas, source etc.; emissions in units of CO_2 equivalent):

Calculation of the fuel shares in the end energy consumption of sector z in the two years preceding the reported year

The data for the fuel mix by sectors for the end energy consumption on national or regional level are taken from the National Statistical Institute and the EEC growth for the two years preceding the reported year is estimated. The difference of the share of each fuel in the end energy consumption by sectors for the two years preceding the monitoring year is calculated. The baseline fuel mix is corrected in accordance with the data for the fuel mix change.

The correction of the fuel shares in the EEC by sector is made by adding the calculated change of the share of fuel ***i*** to the share of the respective fuel in the end energy consumption in sector ***z*** for the year preceding the reported year.

$$(9)\ SFM_{iz} = SFB_{iz} - \Delta SF_{iz},$$

where:

SFM_{iz}	is the share of fuel ***i*** in the sector ***z*** for the reported year;
SFB_{iz}	is the share of fuel ***i*** in the sector ***z*** for the year before the reported year;
ΔSF_{iz}	is the difference in the fuel ***i*** share in the EEC in sector ***z*** for the two years before the monitoring year.

Calculation of the amounts of each fuel, consumed during the year y in sector z, TJ

The end energy consumption on the project territory for sector ***z*** in the year ***y*** is corrected with the reported growth of the EEC for the two years preceding the reported year. The amount of fuel ***i*** in sector ***z*** is calculated, by multiplying the end enrgy consumption of sector ***z*** for the year ***y*** by the corrected share of fuel $\mathbf{SFM}_{iz}$ for the reported year ***y***:

$$(10)\ FF_{i,y} = EEC_{z,y} * SFM_{iz,y},$$

Where:

$FF_{i,y}$	is the consumption of fuel i in the year ***y;***
$EEC_{z,y}$	is the corrected end energy consumption in sector ***z*** for the reported year ***y***;
$SFM_{iz,y}$	is the corrected share of fuel ***i*** in sector ***z*** for the reported year ***y***;

Calculation of the baseline emissions

The baseline emissions are calculated using the formulas **(3)** and **(4)** as described in it. **B.1.4** in PDD.

D. 1.2. Option 2 – Direct monitoring of emission reductions from the project (values should be consistent with those in section E.):

D.1.2.1. Data to be collected in order to monitor emission reductions from the project, and how these data will be archived:								
ID number	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

The monitoring is made by calculating method. Direct monitoring is not expected.

D.1.2.2. Description of formulae used to calculate emission reductions from the project (for each gas, source etc.; emissions/emission reductions in units of CO_2 equivalent):

The monitoring is made by calculating method. Direct monitoring is not expected.

D.1.3. Treatment of leakage in the monitoring plan:

D.1.3.1. If applicable, please describe the data and information that will be collected in order to monitor leakage effects of the project:								
ID number	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
1.	Quantity of purchased natural gas	Annual statement for delivery between Gazosnabdyavane Burgas EAD and Bulgargas EAD	sm^3	m	Monthly and annual	Annual delivery	Electronic/pape r	
2.	Quantity of sold natural gas	Monthly sales reports by sectors from Gazosnabdyavane Burgas EAD	sm^3	c	Annual	Annual delivery	Electronic/pape r	
3	Natural gas leakages resulting from GDN failures	GDN failure protocol	sm^3	e	Monthly	Quantity of natural gas released	Electronic/pape r	

D.1.3.2. Description of formulae used to estimate leakage (for each gas, source etc.; emissions in units of CO_2 equivalent):

In the project the leakages from the transmission and distribution of natural gas and the off-site emissions from the underground mining and the post-mining activities are considered. The leakages from the transmission and distribution and the leakages from the mining and the post-mining activities of the replaced coal include the

methane emissions.The leakages are calculated in accordance with the 2006 IPCC Guidelines for National Greenhouse Gas Inventories[18] on Tier 1 level. The leakages from the transmission and distribution of natural gas are calculated on the basis of the quantity of natural gas transmitted and distributed and of the emission factors indicated in table 4.2.5 of the Guidelines. The leakages from the mining and the post-mining activities of the replaced coal are calculated on the basis of the quantity of coal replaced and of the emission factors indicated in chapter 4.1.3.2 of the Guidelines.

The leakages LE_y with the project implementation are defined as the difference between the leakages from the transmission and distribution of natural gas $LE_{NG,y}$ and the leakages from the mining and the post-mining activities of the replaced coal $LE_{coal,y}$ using the formula:

$$(11)\ LE_y = LE_{NG,y} - LE_{Coal,y}$$

The leakages from the transmission and distribution of natural gas $LE_{NG,y}$ are calculated using the formula:

$$(12)\ LE_{NG,y} = LE_{CH4gtr,y} + LE_{CH4distr,y}$$

where:

$LE_{CH4gtr,y}$ The methane leakages from the transmission of natural gas through the main gas pipeline during the year y in tCO_2e;
$LE_{CH4distr,y}$ The methane leakages from the distribution of natural gas during the year y in tCO_2e.

The methane leakages from the transmission of natural gas through the main gas pipeline during the year y are calculated using the formula:

$$(13)\ LE_{CH4gtr,y} = FF_{NG,y} * EF_{CH4gtr} * GWP_{CH4}$$

where:

$FF_{NG,y}$ The quantity of natural gas that will be combusted with the project implementation during the year y in 1000 m^3;
EF_{CH4gtr} Emission factor for methane leakages from the transmission of natural gas in $tCH_4/1000\ m^3$;
GWP_{CH4} Global warming potential of methane.

The methane leakages from the distribution of natural gas during the year y are calculated using the formula:

$$(14)\ LE_{CH4distr,y} = FF_{NG,y} * EF_{CH4distr} * GWP_{CH4.}$$

[18] 2006 IPCC Guidelines for National Greenhouse Gas Inventories

where:

$EF_{CH4distr}$ Emission factor for methane leakages from the distribution of natural gas in $tCH_4/1000\ m^3$.

The leakages from the mining and the post-mining activities of the replaced coal $LE_{coal,y}$ are calculated using the formula:

$$(15)\ LE_{Coal,y} = LE_{CH4um,y} + LE_{CH4pma,y}$$

where:

$LE_{CH4um,y}$ The methane leakages from the underground mining of coal during the year ***y*** in tCO_2e;

$LE_{CH4pma,y}$ The methane leakages from the post-mining activities for coal extracted from underground mines during the year ***y*** in tCO_2e.

The methane leakages from the underground mining of coal during the year ***y*** are calculated using the formula:

$$(16)\ LE_{CH4um,y} = FF_{coal,y} * EF_{CH4um} * \rho_{CH4} * GWP_{CH4}$$

where:

$FF_{coal,y}$ The quantity of coal replaced with the implementation of the project during year *y* in tons;

EF_{CH4um} Methane emission factor for underground mining of coal in m^3CH_4/t coal;

ρ_{CH4} Methane density in standard conditions, (0.67 kg/m^3 according to IPCC 2006).

The methane leakages from the post-mining activities for coal extracted from underground mines during the year ***y*** are calculated using the formula:

$$(17)\ LE_{CH4pma,y} = FF_{coal,y} * EF_{CH4pma} * \rho_{CH4} * GWP_{CH4}$$

where:

EF_{CH4pma} Methane emission factor from post-mining activities for coal extracted from underground mines in m^3CH_4/t coal.

The quantity of the replaced coal is calculated using the formula:

$$(18)\ FF_{coal,y} = (FF_{BL\ coal,\ y} - FF_{PR\ coal,\ y})/LHV_{coal} * (FF_{NGreal,y} / FF_{NGpr,y})$$

where:

$FF_{BL\ coal,\ y}$	The quantity of coal used during the year y without the project implementation, TJ;
$FF_{PR\ coal,\ y}$	The quantity of coal used during the year y with the project implementation, TJ;
$FF_{NGreal,y}$	The reported natural gas sales for the year ***y***;
$FF_{NGpr,y}$	The natural gas sales for the year ***y*** according to PDD.

Monitoring of the leakages
Insignificance of leakages, procedure for elimination of failures
The balance of natural gas for the purposes of defining the insignificance of accidental emissions is set on the basis of registered data of the quantities of natural gas at the input and output of the GDN. The information submitted by the "Contracts for delivery, prices and conditions" Department of Overgas Inc. AD indicates that the leakages of Sofiagas EAD are also insignificant and are due to the different time of reporting of the quantities purchased and sold. The GMBs for residential users are not controlled remotely and the simultaneous reading of the indications of all the consumers is impossible. When putting into operation big sections of the GDN, the natural gas volume necessary for initial filling also leads to deviations in the values of natural gas quantities purchased and sold.

The monitoring of the natural gas leakages is done by reporting the volume of natural gas emitted due to failure leakages after breaking of a distribution pipeline and the scavenging prior to repairs and connecting. In all the cases of failure, an emergency act is prepared, which is registered in the GDC and reported in the "GDN management" department as per ***Instruction И 7.05.02.16 for work at the time of failure and emergency situation.***

D.1.4. Description of formulae used to estimate emission reductions for the project (for each gas, source etc.; emissions/emission reductions in units of CO_2 equivalent):

Calculation of the Fuel Switch Emission Reduction Factor with the corrected baseline

Because of the large number of end users and the impossibility to report the share of each fuel replaced in the residential sector for the calculation of the generated emission reduction units is used a fuel switch emission reduction factor.

The factor is calculated after accomplishing the baseline monitoring and defining the expected emission reductions by sectors. The FSERF is obtained by dividing the expected emission reductions by the expected natural gas consumption. It quantifies the efficient emission reduction of the fuel switch from carbon rich solid and liquid fuels to natural gas in real conditions. The FSERF measures the amount of emission reduction units by sectors which are achieved with the sale of 1000 sm^3 natural gas.

This factor is designated as a "Fuel Switch Emission Reduction Factor" (FSERF) and is measured in tCO_{2eq}/ *1000* sm^3. The Fuel Switch Emission Reduction Factor is calculated using the formula:

$$(19)\ FSERF_{y,z} = ERs_{y,z} / FF_{NG\,y,z}$$

where:

$FSERF_{y,z}$ fuel switch emission reduction factor for a respective sector ***z*** during the year ***y***;

$ERs_{y,z}$ emission reductions for sector ***z*** during the year ***y*** in tCO_2e;

$FF_{NGy,z}$ The natural gas quantity that would be combusted in a respective sector ***z*** with the project implementation during the year ***y*** in 1000 sm^3.

Calculation of the ERU generated

The generated emission reductions ***$ERs_{y,z}$*** with the project implementation are calculated using the formula:

$$(20)\ ERrs_{y,z} = FSERF_{z,y} * FFr_{NGy,z}$$

Where:

$ERrs_{y,z}$ generated emission reductions for sector ***z*** during the year ***y*** in tCO_2e;

$FSERF_{y,z}$ fuel switch emission reduction factor for a respective sector ***z*** during the year ***y***.

$FFr_{NGy,z}$ Reported data for the natural gas quantity that has been used in a respective sector ***z*** with the project implementation during the year ***y*** in 1000 sm^3.

D.1.5. Where applicable, in accordance with procedures as required by the host Party, information on the collection and archiving of information on the environmental impacts of the project:

According to the Bulgarian legislation, Overgas Inc. AD is not obliged to collect and archive information conserning the influence of the project on the environment.

The process of construction and exploitation of the GDN is in compliance with the current legislation of the country and the procedures of the company concerning the environmental protection and save exploitation of the networks.

D.2. Quality control (QC) and quality assurance (QA) procedures undertaken for data monitored:		
Data	Uncertainty level of data (high/medium/low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
Not applicable	*Not applicable*	*Not applicable*

Methods for quality control and procedures for quality assurance

The quality of delivery of natural gas, users' consumption and cases of emergency (temperature and pressure alarm levels, gas leakage, presence of electric power at measuring units, facilities security, and calls by consumers) in the Gas Distribution Network are monitored by an automatic dispatcher system OVERCOMM 2.0. In *Annex 3* detailed information about the automatic dispatcher system is presented.

The data collected to perform the monitoring (project activity) and the methods of measurement are shown in *Annex 3*.

Statistical methods used in determining the consumed natural gas quantities

To carry out the monitoring as described in item D.1.1.1., the annual natural gas consumption by sectors will be used as an indicator. The methods for determination of the consumed natural gas quantities are presented in *Annex 3*.

D.3. Please describe the operational and management structure that the project operator will apply in implementing the monitoring plan:

Responsibilities for the activities providing for monitoring

- Gazosnabdyavane Burgas EAD will collect the data for buying quantities of natural gas from Bulgargas AD and will report on month natural gas consumption of end users by sectors;
- Overgas Inc. AD will summarize the data for the total natural gas consumption by sectors in an annual report;
- Overgas Inc. AD will prepare a report on the total realized carbon dioxide emission reductions in ERUs;
- Overgas Inc. AD will recalculate the measured quantity to a fixed calorific value of 0.0334 TJ/1000 sm^3.

In *Annex 3* the company procedures of Overgas Inc. AD for quality assurance of operation and reporting on natural gas consumption and leakage are listed.

D.4. Name of person(s)/entity(ies) establishing the monitoring plan:

Overgas Inc. AD
Stela Blagova, Director Ecology and Sustainable Development
Tel.: +359 2 42 83 360
Fax: +359 2 96 21 724
E-mail: stela_blagova@overgas.bg

SECTION E. Estimation of greenhouse gas emission reductions

E.1. Estimated project emissions:

The total project emissions are influenced by the following factors:

- Amount of the replaced fuels;

- Energy efficiency of the combustion installations before and after the gasification;
- Carbon dioxide emission factors of the substituted fuels.

The expected annual consumption of natural gas and the other energy sources during the project implementation is calculated as follows:

- Determination of the fuels' amounts replaced by natural gas by type of the fuel and by sectors;
- Calculation of the quantity of natural gas equivalent to the replaced energy sources;
- Calculation of the energy sources quantities by sectors, as a difference between fuels quantity without project implementation and the amount of the replaced energy sources;
- Calculation of the project emissions released by the end-users' combustion installations.

Determination of the volume of the fuels replaced by natural gas, by types of fuel and by sectors
During the observed period, the project stipulates gradual replacement of solid and liquid fuels used in industry, public and administrative sector and households with natural gas. Initially, the industrial enterprises which use heavy fuel oil, and the municipal facilities, which use mainly gas oil, will switch to natural gas.

Calculation of the quantities of natural gas equivalent to the replaced fuels
The calculation of the quantities of natural gas equivalent to the replaced fuel is made using a fuel conversion factor, which takes into account the change in the energy efficiency of the combustion installations. The data about the energy efficiency of the combustion installations by fuels and sectors are based on the marketing study, expert evaluations and data from references.[19] [20] [21] [22]

Conversion factor for the different types of fuel	*Dimension*	*Industrial sector*	*Public and administrative sector*	*Residential sector*
Heavy fuel oil	1000 sm^3/t	1.070	1.070	-
Gas oil	1000 sm^3/t	1.227	1.227	1.115
Brown coal	1000 sm^3/t	0.263	0.263	0.244
Anthracite and black coal	1000 sm^3/t	-	-	0.551
Briquettes	1000 sm^3/t	-	-	0.411
Wood	1000 sm^3/t	0.216	0.216	0.216
LPG	1000 sm^3/t	1.416	1.416	1.401
Electricity	1000 sm^3/GWh	117.37	117.37	117.37

Table 9: Conversion factors for the different type of fuels

Using the formula for the fuels conversion factor (Formula 6) the values have been calculated for K_i for each type of fuel and each sector (Table 9).

Calculation of the end energy consumption by fuels and by sectors with the project implementation
The change in the structure of the used fuels as a result of the stage-by-stage increase of the used natural gas in Burgas Municipality is shown in *Table 10.*

[19] *Heating, Ventilation and Air-conditioning Equipment, Prof. V. I. Ivanov, Dr. B. M. Krapchev, Technica State Publishing House, Sofia, 1978.*
[20] *Manual on Heating, Ventilation and Air-conditioning, Part 2, Heating and Heat Supply, editor: Prof. Dr. S. Stamov, Technica Publishing House, Sofia, 1991*
[21] *Catalogues of Boiler Construction AD, Sofia*
[22] *Heating, air conditioning and heat installations, I. V. Vuchev, N.D. Minchev. DI "Technika", Sofia, 1962.*

Energy source	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*
Heavy fuel oil	294	213	110	60	54	48	36	27	17	14	2	1
Gas oil	312	268	227	168	153	126	111	69	63	52	43	24
Brown coal	16	14	7	4	3	3	1	0	0	0	0	0
Black and anthracite coal	285	281	255	240	226	214	179	153	126	102	51	28
Wood	438	430	425	410	390	370	340	299	270	255	216	205
LPG	51	46	43	35	24	14	11	10	10	9	8	7
Electricity	2 781	2 824	2 833	2 822	2 823	2 831	2 876	2 923	2 945	2 959	3 054	3 125
Natural gas	20	202	456	707	870	1 036	1 178	1 343	1 496	1 648	1 758	1 858
Total	4 197	4 278	4 356	4 446	4 543	4 642	4 732	4 824	4 927	5 039	5 132	5 248

Table 10: Structure of the energy sources with project implementation, TJ

Calculation of the total project emissions
The total project emissions include direct on-site and off-site emissions.

Based on the projected fuel consumption during the project implementation and emission factors the volume of greenhouse gas emissions is calculated by sectors and years. Data for greenhouse gas emissions for the period of 2008-2017 are given in *Table 11*.

Year	*Industrial sector*	*Public and administrative sector*	*Residential sector*	*Total*
2008	135 478	133 342	618 394	887 215
2009	133 215	135 216	619 198	887 630
2010	134 080	139 397	619 606	893 083
2011	136 906	145 193	618 434	900 533
2012	142 925	152 895	619 511	915 331
2013	142 114	167 447	621 881	931 442
2014	142 896	175 560	623 671	942 128
2015	146 369	179 584	625 211	951 163
2016	152 085	188 864	636 633	977 582
2017	156 624	199 222	643 788	999 634

Table 11: Greenhouse gas emissions with project implementation by sectors, tCO_2

E.2. Estimated leakage:

The leakages are calculated in accordance with the 2006 IPCC Guidelines for National Greenhouse Gas inventories[23] on Tier 1 level. The leakages from the transmission and distribution of natural gas are calculated on the basis of the quantity of natural gas transmitted and distributed and of the emission factors indicated in table 4.2.5 of the Guidelines. The leakages from the mining and the post-mining activities of the replaced coal are calculated on the basis of the quantity of coal replaced and of the emission factors indicated in chapter 4.1.3.2 of the Guidelines.

The released CH_4 emissions from the transmission and distribution of 35 268 thousand m^3 natural gas in the year 2012 are 1 802 tCO_2e or 0.2% from the project emissions.

The leakages from the underground mining and the post-mining activities $\boldsymbol{LE}_{FF,y}$ from 7129 t replaced coal in the year 2012 are 2 056 tCO_2e.

To calculate the total leakages during year ***y***, the emissions generated by the mining and the post-mining activities of the replaced coal are substracted from the emissions generated by the transmission and distribution of natural gas. The resultant the leakages for the period 2008-2012 are negligible (-151 tCO_2e) and they are not included in the calculations of the emission reductions.

E.3. The sum of E.1. and E.2.:

The specific project conditions are a precondition for estimating leakages as negligible and for not taking into account in the project emissions calculation.

E.4. Estimated baseline emissions:

Year	Industrial sector	Public and administrative sector	Residential sector	Total
2005	132 435	110 165	549 073	791 673
2006	144 812	124 217	606 088	875 117
2007	147 997	130 304	616 998	895 299
2008	151 253	136 689	628 104	916 045
2009	154 581	143 386	639 409	937 377
2010	157 982	150 412	650 919	959 313
2011	161 457	157 783	662 635	981 875
2012	165 009	165 514	674 563	1 005 086
2013	168 640	173 624	686 705	1 028 968
2014	172 350	182 132	699 066	1 053 547
2015	176 141	191 056	711 649	1 078 846
2016	180 016	200 418	724 458	1 104 893
2017	183 977	210 238	737 499	1 131 714

Table 12: Greenhouse gas emissions without project implementation - baseline, tCO_2e

[23] 2006 IPCC Guidelines for National Greenhouse Gas Inventories

E.5. Difference between E.4. and E.3. representing the emission reductions of the project:

The total greenhouse gas emission reduction was calculated by deduction from the baseline emissions of the total amount emissions from the implementation of the project. The results are presented in *Table 13.*

E.6. Table providing values obtained when applying formulae above:

Expected amount of emission reduction units with project implementation

	Estimated project emissions (tCO_{2e})	*Estimated leakage (tCO_{2e})*	*Estimated baseline emissions (tCO_{2e})*	*Estimated emission reductions (tCO_{2e})*
2005	791 673	0	791 673	0
2006	872 738	0	875 116	2 378
2007	884 828	0	895 299	10 471
2008	887 215	0	916 045	28 830
2009	887 630	0	937 377	49 747
2010	893 083	0	959 313	66 230
2011	900 533	0	981 875	81 342
2012	915 331	0	1 005 086	89 755
2013	931 442	0	1 028 968	97 527
2014	942 128	0	1 053 547	111 419
2015	951 163	0	1 078 846	127 683
2016	977 582	0	1 104 892	127 310
2017	999 634	0	1 131 714	132 079
Total	***11 834 980***	***0***	***12 759 751***	***924 771***

Table 13: Greenhouse gas emission reductions, tCO_{2e}

	2006	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*
Industrial sector	2 341	9 565	15 775	21 366	23 901	24 551	22 085	26 526	29 454	29 773	27 931	27 353
Public and administrative sector	37	633	3 346	8 170	11 016	12 590	12 618	6 177	6 571	11 472	11 554	11 016
Residential sector	0	273	9 709	20 211	31 313	44 201	55 052	64 824	75 394	86 438	87 825	93 710
Total	2 378	10 471	28 830	49 747	66 230	81 342	89 755	97 527	111419	127683	127310	132079

Table 14: Greenhouse gas emission reductions by sectors, tCO_{2e}

A reduction of **315 904** tCO_{2e} will be achieved with the project implementation during the period **2008-2012.**

The implementation of the project will reduce the carbon dioxide emissions by **12 849** tons until the end of **2007.**

A reduction of **596 018** tCO_{2e} will be achieved with the project implementation during the period **2013-2017.**

SECTION F. Environmental impacts

F.1. Documentation on the analysis of the environmental impacts of the project, including transboundary impacts, in accordance with procedures as determined by the host Party:

➢ **Regulatory environment protection measures, requisite for 'Distribution of Natural Gas' and 'Public Supply of Natural Gas'.**

The environment protection requisites are defined by the Environment Protection Act (EPA), promulgated in the State Gazette, # 91 dd. 25 Sept. 2002, amended in # 30 dd. 11 April 2006. Pursuant to Section 81, para 1, item 2: "Environmental Impact Assessment is required for investment construction projects, operations and technologies listed in Annexes 1 and 2".

The activities: 'Distribution of Natural Gas' and 'Public Supply of Natural gas' fall into the scope of Annex 2 and, pursuant to Section 93, para 1, item 1 of the EPA, require a decision by the competent authority (Regional Inspectorate of Environment and Water (RIEW)) on the necessity of assessment of the environmental impact.

The necessity of the Environmental Impact Assessment (EIA) is to be decided on by the Director of the relevant RIEW for each individual case with consideration of the criteria defined by para 4 of Section 93 of the EPA and the provisions of the Regulation on the Terms and Procedures for Environmental Impact Assessment (Council of Ministers' Decree /CMD/ # 59/07.03.2003, as amended in SG # 3/10.01.2006)

Pursuant to the provision of the EPA and the above mentioned Regulation, the environment impact assessment of investment projects should be carried out in the following sequence:

- The Investor/Principal notifies in writing the relevant authorities (MoEW/RIEW) of its investment project during the procedure of pre-investment surveys.

- Simultaneously with the notification to the relevant authority, the Investor/Principal shall notify in writing the Mayor of the municipality(ies), district(s) and or town halls concerned, and also it shall inform the respective population through the mass media and/or other suitable means.

- On the grounds of this notification, the relevant authority (RIEW) decides whether the investment project shall be covered by Annex 1 or Annex 2 of Section 81, para 1. item 2 of the EPA. The relevant authority shall, within 14 days, notify in writing the Investor/Principal about the required steps which the latter should undertake.

- For assessment of the necessity of a EIA for the projects covered by section 93, para 1 of the EPA, the Investor/Principal shall submit a written application to the competent authority, as defined in Section 93, para 2 or 3 of the EPA, with enclosed information in conformity with Annex 2 and information reflecting the public interest to the investment project, if any exists.

- Within one month from the date of submission of the application stipulated by section 6 of Regulation on the terms and procedures for environmental impact assessment, the competent authority shall come out with a decision on the necessity of carrying out an EIA.

Overgas Inc. AD and Gazosnabdyavane Burgas EAD strictly observe this procedure and currently has submitted applications on the necessity of assessment of the environmental impact and has received decisions of the Competent Authority for 5 sites (parts of the investment proposal), which are prepared for receiving a permission for construction in accordance with the construction plan that no Environmental impact assessment is required as follows:

- Gasification of Burgas – Construction of a gas distribution pipeline up to the Burgas City urban-planned area, Lozovo district and Dolno Ezerovo; Decision of the RIEW – Burgas, # БС-353-ПР/2005;
- Gasification of Burgas – Construction of gas distribution pipeline, gas pipeline branches to consumers in Industrial Zone 1—North; Decision of the RIEW – Burgas, # БС-364-ПР/2005;
- Gasification of Burgas – Construction of gas distribution pipeline, gas-pipeline branches to consumers in Residential Zones 1 and 2; Decision of the RIEW – Burgas, # БС-379-ПР/2005;
- Gasification of Burgas – Construction of gas distribution pipeline, gas-pipeline branches to consumers in Industrial Zone 1—South; Decision of the RIEW – Burgas, # БС-215-ПР/2006;
- Gasification of Burgas – Construction of gas distribution pipeline, gas-pipeline branches to consumers in Residential Zones 3 and 4; Decision of the RIEW – Burgas, # БС-216-ПР/2006;

The same procedure will be observed and for the other sites following the plan for the project implementation.

F.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to supporting documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

Overgas Inc. AD observes and complies with the requirements of all regulations on environment protection while implementing its investment projects for construction of gas distribution pipelines, gas-pipe branches and facilities to individual consumers, as well as the gas distribution network on the territory of Burgas municipality.

This is confirmed by the decisions of the RIEW Burgas (on the grounds of Section 93, para 5 of the EPA and the Regulation on the Terms and Procedures of Assessing the Environmental Impact) that no Environmental impact assessment is required for the investment projects. *(Annex 10)*

The gasification of Burgas Municipality has no negative impact on the environment. As a result of the project implementation improvement of the ambient air quality on the territory of Burgas municipality will be achieved.

SECTION G. Stakeholders' comments

G.1. Information on stakeholders' comments on the project, as appropriate:

During the construction of gas transportation and distribution networks within and outside the urban territories on each stage the following involved stakeholders are strongly engaged:

- The cities population;
- Municipal administrations;
- Specialized state supervisory bodies;
- Communications companies.

No objections or negative opinions regarding the size and plan of the gasification facilities have been received in relation to the gasification of the territory of Burgas Municipality, covered by the license of Gazosnabdyavane Burgas EAD.

The applicable procedure, as defined by the currently valid environment protection legislation concerning the decision of the competent body on the need of EIA of the investment project, is described in item F.1. This procedure provides for the supervisory body's competence, in case any premises are available, to require an EIA given by independent experts and to offer the investment project for general public discussion.

We should also mention the following phases of procedures by which the public and stakeholders were introduced to the project:

- Pre-feasibility study for Burgas were reviewed and approved by a special committee of Burgas Municipality;
- Complete information on the existing engineering infrastructure on the city's territory has been obtained from the Electricity Mains Service, the Water Supply and Sewerage Service, the Bulgarian Telecom Company, the Cable Lines Service;
- Design documents for 131 km pipelines have been prepared;
- The design documents for 90 km have been coordinated in conformity with the provisions of the Structure of the Territory Act with: the State Technical Supervision Authority, the Regional Fire Safety Service and the Executive Agency for Routs. The construction designs were approved without any objections. The coordinated designs were approved by the municipal administration and relevant permits were obtained for construction of the facilities;
- In conformity with legislative provisions, all obtained permissions for construction are exhibited at an easily accessible place in the town hall, thus providing information to the public and personally to stakeholders. No objections and comments on the obtained construction permits have been submitted.

Summary

No negative opinions on the project's implementation have been stated, concerning all procedures, which provide for comments and opinions from stakeholders, such as the city's population, municipal administration specialised supervisory bodies, engineering communications providers, experts from research organisations. There is general public interest in the accelerated implementation of the project, positive attitude and awareness of its economic, social and environmental benefits for the town and for all individual consumers.