REDUCTION OF GREENHOUSE GASES BY GASIFICATION
in Varna municipality

JI Project Design Document

ERUPT 5

Sofia, February 2005

C O N T E N T S

Appendices

Appendix 1	Information about end-users
Appendix 2	Map of the project "Gasification in Varna municipality"
Appendix 3	Letter from State Energy Regulatory Commission
Appendix 4	Plan for construction of gas distribution network and facilities in Varna municipality
Appendix 5	Number of the end-users provided for gasification in Varna municipality, by years and sectors
Appendix 6	Prices of energy sources
Appendix 7	Company procedures of Overgas Inc. AD ensuring the quality in the operation, identification and removal of unregulated outflow of natural gas and measuring of natural gas
Appendix 8:	Description of the automatic dispatcher system OVERCOMM 2.0.
Appendix 9:	Data collected to perform monitoring (tracing the project activity)
Appendix 10:	Methods used in determining the consumption of natural gas at standard conditions
Appendix 11:	Resolution on the necessity of environmental impact assessment No 55ПР/2003
Appendix 12:	Resolution on the Environmental impact assessment report No 10-2 (50) 1998
Appendix 12.1:	Extension of the term of resolution on Environmental Impact Assessment No 10-2 (50) 1998
Appendix 12.2:	Extension of the term of resolution on Environmental Impact Assessment No 10-2 (50) 1998
Appendix 12.3:	Extension of the term of resolution on Environmental Impact Assessment No 10-2 (50) 1998

1. PROJECT INFORMATION

1.1. Project characteristics

Company name:	**Overgas Inc. AD**
Visiting address: **Zip code + city:**	5, Philip Kutev str. 1407 Sofia
Postal address: **Zip code + city:**	P.O.Box 104 1407 Sofia
Country:	Republic of Bulgaria
Contact person: **Job title:**	Mrs. Stela Blagova Head of Ecology and Sustainable Development Dept.
Telephone number:	+359 2 96 03 360
Fax number:	+359 2 962 17 24
E-mail:	stela_blagova@overgas.bg
Website URL:	www.overgas.bg
Number of Employees: **Registration number in the Bulgarian Chamber of Commerce and Industry:**	175 № 4048730300/01.12.1995 Sofia
Date of registration:	Company case №30913/1992 Sofia District Court
Bank account number:	Account in EUR № 1426217210 SWIFT CODE: UBBSBGSF
Bank name:	CB United Bulgarian Bank AD
Company's core business:	Overgas Inc. AD invests in gas distribution networks by holding majority interest in 26 local gas distribution companies. The activity of Overgas Inc. AD includes marketing and feasibility studies, analysis, assessment and elaboration of gas projects, production, contracting, agency and trade in fuels and energy sources; investments in municipal and urban infrastructure, including gasification, district heating systems, power supply and water supply.

1.2. Project partners:

1.2.1.	**Company name:**	**Varna municipality**
	Visiting address:	43, Osmi primorski polk bul.
	Zip code + city:	9000 Varna
	Postal address:	43, Osmi primorski polk bul.
	Zip code + city:	9000 Varna
	Country:	Republic of Bulgaria
	Website URL:	http://www.varna.bg/index.htm
	Contact person:	Mr. Kiril Yordanov
	Job title:	Mayor
	Telephone number:	+359 52 600 616
	Fax number:	+359 52 605 757
	Number of Employees:	313

1.2.2.	**Company name:**	**Varnagas AD**
	Visiting address:	1, Drin str.
	Zip code + city:	9000 Varna
	Postal address:	31, Al. Dyakovich str.
	Zip code + city:	9000 Varna
	Country:	Republic of Bulgaria
	Contact person:	Mr. Svetoslav Ivanov
	Job title:	Executive Director
	Telephone number:	+359 52 663 828
	Fax number:	+359 52 663 834
	E-mail:	varnagas@overgas.bg
	Number od Employees:	27
	Date of registration:	Company case N 1395/1997 Varna District Court
	Company's core business:	Varnagas AD is a subsidiary company of Overgas Inc. AD established for implementation of natural gas distribution activity, marketing, promotion and sales activities in Varna. As a major shareholder in Varnagas AD, Overgas Inc. AD manages and controls the company. *Appendix 1* presents the information about the industrial and the public and administrative users of natural gas in Varna municipality.

1.2.3. Company name:	***Gastec BG AD***
Visiting address:	5, Philip Kutev str.
Zip code + city:	1407 Sofia
Postal address:	5, Philip Kutev str.
Zip code + city:	1407 Sofia
Country:	Republic of Bulgaria
Contact person:	Mr. Alexander Levashki
Job title:	Executive Director
Telephone number:	+359 2 96 03 425
Fax number:	+359 2 962 17 63
E-mail:	alexander_levashki@overgas.bg
Number of Employees:	69
Date of registration:	Company case № 15645/1995 Sofia District Court
Company's core business:	Consulting, research and project design for gas distribution networks, gas facilities and installations, technical supervision of gas installations, calibrations of natural gas metering devices, training of employees in the field of gas technologies, consultation on natural gas utilization, marketing and sales.

1.2.3. Company name:	***Overgas Engineering AD***
Visiting address:	5, Philip Kutev str.
Zip code + city:	1407 Sofia
Postal address:	14, Tsar Simeon str.
Zip code + city:	8600 Yambol
Country:	Republic of Bulgaria
Contact person:	Mr. Stoicho Ilkov
Job title:	Executive director
Telephone number:	+359 2 96 03 485
Fax number:	+359 2 962 21 93
E-mail:	engineering@overgas.bg
Number of Employees:	167
Registration number in the Bulgarian Chamber of Commerce and Industry:	№4034389200/30.03.1999 Sofia
Date of registration:	Company case №532/1993 Yambol District Court
Company's core business:	Building and construction engineering activity in the field of oil and gas.

1.2 Project Abstract

- ***Project Title***

REDUCTION OF GREENHOUSE GASES BY GASIFICATION
in Varna municipality

- ***Abstract***

The project aims at the reduction of greenhouse gases in Varna municipality by switching to natural gas from liquid and solid fuels and electricity used by end-users and increasing the energy efficiency of their combustion installations.
The project involves construction of a gas distribution network in Varna municipality and reconstruction of end-users' combustion installations in industrial, public and administrative sectors, and households.
The support of SenterNovem under the Joint Implementation Mechanism has a significant importance for the project implementation, which will contribute considerably to the sustainable development of the Municipality.

- ***Project location***

Host country **Republic of Bulgaria**

Varna municipality is located on the northern Black Sea coast. (Fig. 1) Varna is the third Bulgarian biggest town and occupies an area of 205 km^2. The municipality includes the districts of Asparouhovo, Vladislav Varnenchik, Mladost, Odesos, Primorski and the mayoralties of Topoli, Kamenar, Zvezditsa, Kazashko, Konstantinovo. The population of Varna municipality is 352 161 people. Varna is an important tourist centre in Bulgaria. Demonstration of the comfort of modern natural gas applications will support the further use of natural gas in Bulgaria.

Figure 1: Map of the Republic of Bulgaria

- **Project preliminaries and creating preconditions** **till the end of 2004**
- **Construction starting date** **2005**
- **Construction finishing date** **2012**

On receiving the revenues from the ERUPT 5 program, the main gas distribution network will be constructed by the end of 2008. The additional initial financing is crucial to the start of the project.
The further development of the gas distribution networks is related to the capacity to connect new users – newly created enterprises, municipal sites and households, thus leading to a need to expand the networks.

1.3. Background and justification

Gasification - definition

The gasification involves the following activities:

- Bringing natural gas to end-users by constructing a distribution network;
- Restructuring of combustion installations and switching to natural gas from fuels, used by end-users in industrial, public and administrative sectors, and households;
- Advancement of the use of natural gas by an intensive marketing and public relation campaign;
- Support to end-users on buying natural gas utilization equipment.

1.3.1. History and preconditions for the initiation of the project

The gasification activity is regulated by the law requirements for obtaining a license, which gives rights for performing the activity gas distribution. The license of Varnagas AD, which defines the project scope, covers all individual industrial enterprises, users in the public and administrative and residential sectors in residential suburbs without district heating, as well as vacation resorts in districts Odesos and Primorski and the mayoralty of Topoli, Kamenar, Zvezditsa, Kazashko and Konstantinovo.

In the three consumer sectors, the end-users use various energy sources. The non-gasified industrial enterprises and the buildings in the public sector use boilers operating mostly on liquid fuels – heavy fuel oil and gas oil. Low efficiency boilers on solid and liquid fuels are used in the residential and public and administrative sectors.
Most of combustion installations are operated on low energy efficiency. The energy efficiency at end-users from the three sectors is different. The transition of the end users to a new fuel – natural gas needs overcoming of cultural, technological and financial barriers. Advance financing provided by SenterNovem will catalyze the project development and will facilitate the financing to a great extent in the initial stage.

The memorandums of understanding signed by the Government of Bulgaria and the growing demand for reduced emissions on behalf of specialized bank funds and Government agencies, as well as the approval of the gasification projects as JI projects by the Validation agencies and Ministry of Environment and Water provide further assurance for Overgas Inc. AD when taking the decision for starting the gasification in Varna.

The project boundaries encompass the territory covered by the license issued to Varnagas AD: the districts of Odesos, Prirmosrki (including the vacation resorts St. Constantine i Elena, Zlatni Pyassatsi, Riviera), and the mayoralties of Topoli, Kamenar, Zvezditsa, Kazashko and Konstantinovo. (*Appendix 2)*

The project **Reduction of Greenhouse Gases by Gasification in Varna municipality** includes gasification of industrial, public and administrative and residential consumers who use solid and liquid fuels and electricity on the territory covered by the license issued to ***Varnagas AD***. Gas supplying pipelines (16 bar and 10 bar working pressures) and gas distribution network (4 bar working pressures) will be constructed for supply of the main users in the three sectors.
Gasification creates opportunities for expanded use of cogeneration, which will reduce the carbon dioxide emissions.

1.3.2. Problems to be solved by the implementation of the project

Since 1977 the Heating Plants and part of the industrial enterprises in Varna municipality have been using natural gas for heat generation. Regardless of the recent favorable changes in legislation and pricing, until now the public and administrative users and households have not been using natural gas. This is mostly due to 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 sector and households.

The project implementation is of strategic regional importance and has an economic, social and environmental impact with respect to the following:

- Improvement of the municipality environment;
- Introduction of modern technologies, e.g. low-cost advanced room temperature control systems;
- Reduction of energy consumption per unit of GDP;
- Less costly production/services as a result of using cheaper fuel;
- Opportunity for the public and administrative, and residential sectors to use cheap and environmental friendly fuel;
- Possibility for use of up-to-date combustion installations in the households;
- Reduced unemployment rates.

The project implementation will solve users difficulties related to the regular supply and storage of the solid and liquid fuels currently in use.

The support of the Dutch Government, the validation of the project results report by an independent company and the approval of the Ministry of Environment and Water are crucial for the project implementation. All these circumstances facilitate the obtaining of bank loans for financing the construction of gas distribution infrastructure. Providing sufficient funds for the initial stage of the project is of paramount importance for its development rates till 2012.

1.3.3. Core business of project partners and description of their relations

Overgas Inc. AD is a leading company in the project. Gastec BG AD and Overgas Engineering AD are partners and subcontractors of Overgas Inc. AD. Varnagas AD is the "operating company" of the project, i.e. the distribution company, which will sell gas to end-users. Varna municipality is an owner of part of the sites in the public and administrative sector and actively supports the gasification project.

Overgas Inc. AD is the largest private investor on the natural gas market in Bulgaria. The company has experience, professional potential and financial resources to guarantee its partners and customers reliable implementation of all projects and to support the development of natural gas market in Bulgaria. Overgas Inc. AD has conducted marketing and feasibility studies related to the gasification of Varna municipality. As a main investor "Overgas Inc." AD will operate the investment process.
In earlier projects, also in ERUPT 3 and ERUPT 4, Overgas Inc. AD proves to be competent in switching over the end-users to natural gas. Besides in providing the physical connection, Overgas Inc. AD also provides the right organisational, marketing and technology tools to convince the end-users.
(Enclosed in PIN Reference regarding implementation of similar projects by Overgas Inc. AD and references)

Varnagas AD is a joint-stock company with shareholders Overgas Inc. AD and Varna municipality. Overgas Inc. AD has a majority share in Varnagas AD and controls and manages the company. Varnagas AD has a license from the State Energy Regulatory

Commission to perform the activity of natural gas distribution on the territory of Varna municipality excluding the districts Vl. Varnenchik, Mladost and Asparouhovo. The company will supply and sell natural gas to the end-users. The company will ensure safe and flawless operation of the gas transmission network and its adjacent facilities thus guaranteeing safe and reliable gas supply to the end-users.

Varna municipality
Varna municipality is a shareholder of Varnagas AD, and as such it takes part in the process of supplying natural gas to end-users and in the development of the gas transmission network on the territory covered by the license. Varna municipality is the owner of part of the sites from the public and administrative sector and participates in the project as an investor in constructing indoor gas installations at municipal sites. The implementation of the project for gasification in Varna municipality will promote the development of the municipality in economic, social and ecological aspects.

Gastec BG AD is a joint-stock company with shareholders Overgas Inc. AD, Overgas Holding AD and GASTEC NV-the Netherlands. The company develops detailed designs for gas distribution networks, natural gas equipment and indoor installations of users. Gastec BG AD also makes assessments of the environmental impact from the implementation of gasification projects. The company organizes and implements training courses in design, construction and operation of gas distribution systems and gas installations. Gastec BG AD also conducts technical supervision over gas facilities and installations.
(Enclosed in PIN Reference with respect to setting up and operating similar projects by Gastec BG AD and references)

Overgas Engineering AD will construct the gas distribution network on the territory covered by the license of Varnagas AD.
(*Enclosed in PIN Reference with respect to setting up and operating similar projects by Overgas Engineering AD and references)*

End-users
The end-users in the industrial, public and administrative sectors represent over 23% of the total amount ERUs for the project, as a result of the fuel switch. Therefore it is of great importance that at this early stage we have the confirmation of the municipal government and company managers that they will switch to natural gas and that the emission reduction units generated by them will be added to the total ERUs for the Overgas Inc. AD project. This is confirmed by the declarations from the managers of these companies.

The General Conditions of the natural gas sale contracts between Varnagas AD and the end-users will include a clause that the emission reduction units they generate will be transferred to the total emission reduction units under Project Reduction of Greenhouse Gases by Gasification in Varna municipality with supplier Overgas Inc. AD by specially created company operator "Varnagas" AD *(Appendix 3 - Letter from State Energy Regulatory Commission, The original of the letter is enclosed in PIN)*

1.3.4. Related financial commitments

The volume of investments required for the construction and development of the gas distribution network amounts to EUR 12.1 million. The value of the forthcoming investments required for the fuel switch at the end-users is estimated at EUR 34.5 million. The total approximate value of the required investments is EUR 46.6 million.

The Dutch government's involvement in the project builds greater confidence with the bank institutions and facilitates the negotiations of better financing conditions. Moreover, alongside with the funds generated by the emission reduction sales, it will enhance the project's economic efficiency. This will be felt by users of natural gas as the maximum allowable price for consumers in all sectors will decrease. The funds will support the successful implementation of the program for providing financial instruments to support the switching of end-users to natural gas.

Overgas Inc. AD will ensure the financing of this project with EUR 6.52 million, whereof EUR 2.02 million as a shareholders equity share of Overgas Inc. AD in Varnagas AD, EUR 5.2 million from bank loan and EUR 0.38 million reinvestment from the activity. Overgas Inc. AD as a major owner of Varnagas AD will provide funds to it.
For its part, "Varnagas" AD invests these funds in the implementation of the gasification project in Varna municipality.

To facilitate the fuel switch in households, Overgas Inc. AD in cooperation with bank "HVB Biochim" AD has developed the "Coziness and warmth in your home" technical/financial tool. "Coziness and warmth in your home" provides for:

- Delivery of gas appliances and possibility for buyback of the users' gas installations;
- Financial mechanisms to support end-users:
    - Better terms of consumer loans for purchasing household gasification equipment – without guarantors;
    - Obtaining consumer loans for purchasing household gasification equipment at preferential interest rates;
    - Ability to use a grace period under the consumer loans for purchasing household gasification equipment.

A similar product has also been developed along with DSK Bank EAD.

1.4. Intervention

1.4.1. Project goals

- Supply of natural gas to the potential users on the territory covered by the license of Varnagas AD and development of gasification in Varna Municipality;
- Replacement of currently used solid and liquid fuels and part of the electricity by natural gas from industrial, and public and administrative end-users, and most of the users in the residential sector;
- Reduction of greenhouse gases and delivery of emission reduction units to SenterNovem according to the Joint Implementation mechanism.

1.4.2. Project purpose

Reduction of greenhouse gases by gasification of the end-users on the territory of Varna municipality.

1.4.3. Project results

The results that will be achieved by the implementation of the project are:

- Reduction of greenhouse gases emissions – starting from 39 211 tons $CO_{2eqv.}$ in 2008 and reaching up to 107 861 tons $CO_{2eqv.}$ in 2012;
- Reduction of the total amount of noxious emissions released in the air;
- Enhanced energy efficiency of combustion installations in the region;
- Significant reduction of energy costs for households as a result of increased efficiency of the combustion installations and lower cost of the used energy source;
- Increased living standard: Ensuring a higher level of human health as a result of improved air quality, raising household standards, automation of the combustion process allowing easy and safe operation of gas appliances and opening of new and attractive jobs.

1.4.4. Activities:

- Construction of 186 km gas distribution network;
- Construction of in-house installations of 8 industrial enterprises, 352 sites in the public and administrative sector and over 21 900 households;
- Commissioning and operation of gas distribution networks and end-users' installations (ensuring safe operation of gas distribution networks and regular natural gas supply to the end-users);
- Monitoring of natural gas consumption and resulting emission reduction units.

1.4.5. Detailed project description

The project envisages the construction of 186 km gas distribution network of steel and polyethylene gas pipelines and 22 000 facilities (gas metering and regulating stations, gas metering stations, etc.) in Varna municipality (as of 2012) and reconstruction of the installations of end-users. The gas distribution network includes steel gas pipelines under pressure up to 16 bar and polyethylene gas pipelines under pressure of 10 bar and 4 bar, and it envisages to supply over 60% of the main users in the industrial and public and administrative sectors in Varna municipality by the year 2008. *(Appendix 4: Plan for construction of gas distribution networks and facilities in Varna municipality)*

- ***Industrial sector***

Varna is one of the most important centers of economic development in Bulgaria and has a key role for the national economy. All industrial sectors of the economy are represented in Varna. There are four industrial zones in Varna. The Western Industrial Zone is the largest and most clearly marked one and includes food industries, machine building, warehouses, and construction enterprises.

The industrial enterprises covered by the gasification project include the sewing workshop and the bakery located in the urban area as well as four asphalt bases, one refinery station and plastic-processing factory located in the area of the Topoli village (Klisse Bair).

- ***Public and Administrative sector***

There are a number of higher education institutions, various vocational schools, general education schools and childcare centres. The commercial activity is performed via public food stores and restaurants shop network for food and non-food goods, markets, workshops for various services, offices. Varna municipality has a very good potential for developing various forms of tourism. The favorable climate conditions and natural and historical landmarks as well as the national arts and crafts create conditions for full year development of leisure and recreation, sport activities and tourism.

There are over 200 hotels, food chains and leisure and recreation facilities in Varna. Several large hospitals on the territory of the municipality have regular energy consumption during all the seasons – MHAT St. Marina, MHAT St. Ana, Naval Hospital, Transport Hospital, Ophthalmology Clinic, Gynecology clinic and a number of other medical establishments and outpatient polyclinics.
The higher education schools include the Technical, Medical and Economic Universities.

Three sea resorts of national importance are located to the north of Varna – Zlatni Piasatsi, Riviera and St. Konstantin and Elena that belong to Primorsko municipality. Other resorts included under the same municipality are: St. Nikola, Akchelar, Trakata, Gorna Traka, Evksinograd, Alen Mak, Chaika, Kabakum, Abatko, etc., which have hotels, holiday homes and villas, incl. the Free University of Varna, Sport palace and other large sites. The research made on the above mentioned resorts and districts covers 153 sites, as follows:

- St. Konstantin and Elena resort – 63 sites having a total of 30 boilers;
- Alen Mak and Chaika - 15 sites having a total of 23 boilers;
- Zlatni Piasatsi and Riviera - 75 sites having a total of 23 boilers

- ***Households***

Varna Municipality has a population of 352 161. The coverage of the Varnagas license encompasses 75 731 households with 187 510 citizens (over 53 %). Residential buildings are 19 387, of which 590 made of precast panels, 1 120 of steel-concrete, 8 710 made of bricks with a concrete slab, 6 550 made of bricks, 260 made of stone, 500 made of sun-dried bricks, 1 520 made of wood and 167 made of other materials.

The detailed marketing researches done by Overgas Inc. AD show the growing interest from potential users of natural gas for the faster implementation of this project, as well as replacement of their fuel base and enhancing the energy efficiency. According to 29% of the households, natural gas is their best heating source, 23% believe that electricity is the best energy source and 19% think this is the central heating.
Electricity is the main energy source for virtually all households in the city and 26% use wood. Local heating installations, coal and gas oil are less used.

- ***Stages in the implementation of the project***

During the first stage, the main gas distribution pipelines and facilities are constructed and industrial enterprises are switched to natural gas. During the second stage, public and administrative sites are gasified and residential users gradually switch to natural gas. The gasification covers near 90 municipally owned sites including 50 schools and public education institutions, 30 nursery schools, the City Hall, two museums, two theatres, three hospitals and 2 city halls. The natural gas penetration rate and the expected annual sales, respectively, are calculated including the effect of the additional financing from the sale of ERUs.

The construction of the gas distribution network in Varna municipality will go through the following stages:

- ***1st stage (till the end of 2005)***:

Launch of the construction of the gas distribution network. Building the main steel gas pipeline from AGRS Varna to the territory of the license. Building a supporting polyethylene distribution network in the very center – Varna. Connecting industrial users, the initial users from the public and administrative sector and households.

- ***2nd stage (2006 - 2008)***

During this stage the gasification will expand over the central part of the town, Chaika Complex, Klise Bair Industrial zone, Vinitza neighborhood and part of the urbanized territories to the north of the town. During this period over 9 000 users will switch to natural gas.

- ***3rd stage (2009 - 2012)***

During this period the gasification of households will continue and the already built network will be intensified. The gas distribution network will expand to cover any territorial changes or building of new zones. The network will further penetrate into the urban areas and intensify.

Based on marketing surveys conducted by Overgas Inc. AD users from the three sectors are planned to be connected by the end of 2012 with an estimated annual consumption as follows:

Industrial sector	8 sites	6.1 million sm^3
Public and administrative sector	352 sites	14.2 million sm^3
Residential sector	over 21 900 households	27.6 million sm^3
Total		**47.8 million sm^3**

(Appendix 5: Number of the end-users in Varna municipality provided for gasification)

According the marketing surveys the main parameters of the gas distribution network will be as follows:

Technical capacity (Qmax) – 50 000 sm^3/h (465 MWh)
Expected availability (Qes) – 38 000 sm^3/h (354 MWh)
Expected capacity factor Qmax/Qes – 1,32
Expected level of project activity (Estimated Annual Consumption) – 47.8 million sm^3/a (445 GWh/a), in 2012.

2. DESCRIPTION OF THE CURRENT SITUATION

The block scheme of the current deliveries with its main components and connections is shown in *Figure 2.*

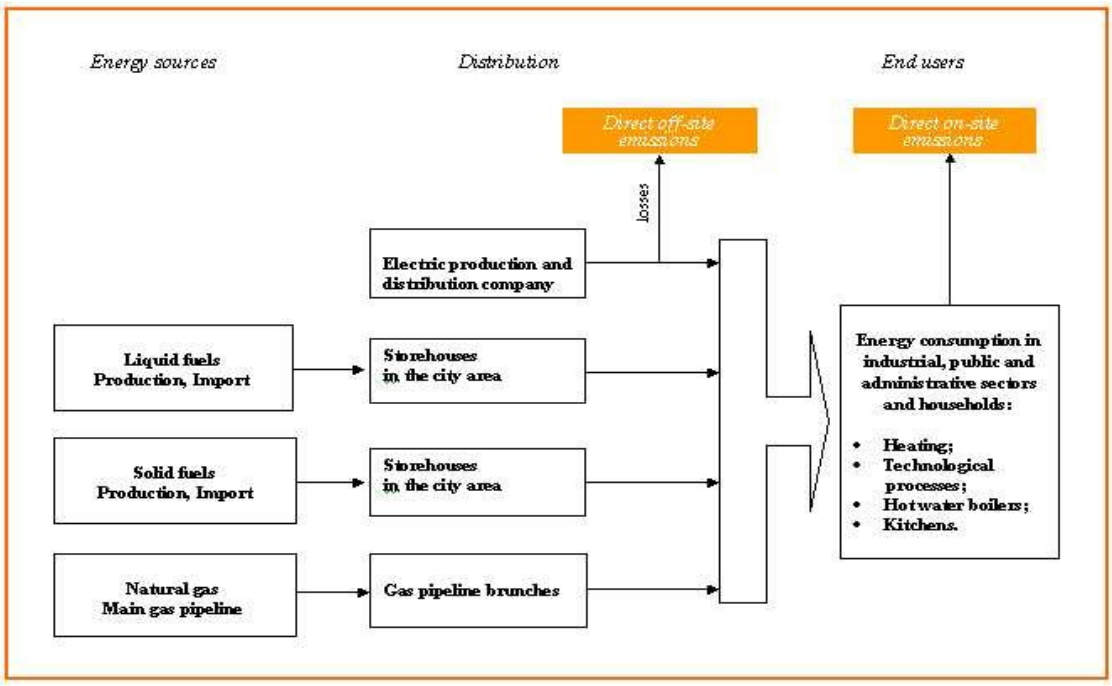

Figure 2: Block scheme of the current delivery system

Information about the status and adequacy of the current delivery system, operation regime of the current delivery system

Varna municipality is currently using solid and liquid fuels, electricity, heating energy and natural gas.

- ***Solid fuels***

Delivery and distribution of solid fuels (wood, coal and briquettes) are provided by many private companies, which have storage facilities in Varna. These companies are mainly distributors of mining enterprises in the sector located on the territory of the Republic of Bulgaria.

Solid fuels are used mainly by households and occasionally by the other sectors. The share of wood used by households is 13.3%. After the gasification the use of woods by the households is expected to gradually decrease.

In Varna municipality, coal and briquettes are delivered from the following larger coalmines: Bobov Dol mines, Pernik mines, Donbas, Kuzbas and Brickel.
The use of wood for heating comprises 10.3%, and that of LPG is 3.2% of the end energy consumption in the project area. There are no grounds to expect that the use of wood or LPG will increase considerably over the project period.

- ***Liquid fuels***

The delivery and distribution of liquid fuel (heavy fuel oil, gas oil, petrol and light ship fuel) is concentrated in private hands both at national and regional level. The main supplier is the oil refinery in Burgas owned by Lukoil AD. There is only a minor share of the fuels that are directly imported. Liquid fuels are used for technological purposes (the largest share), heating and less for hot water boilers. Toplivo EAD is the fuels supplier for Varna municipality. The nearest oil station, which belongs to Naftex Petrol AD is located at the Island Zone. Shell, Toplivo and OMV are among the other large suppliers. Due to the high oil prices, the consumption of liquid fuels for heating is reduced to a minimum.

A trend has been observed in the last three years of decreased use of heavy fuel oil by the large users and switching to industrial gas oil. Emissions are estimated on the basis of updated data provided by users.

- ***Electricity***

Electricity is used for heating and hot water for households and technological needs in the industrial, public and administrative sectors. Electricity has a major share within the energy balance of the household users. A main electricity supplier for the region is Elektrorazpredelenie Varna EAD.

- ***Natural gas***

Natural gas use started in Varna in 1976 - 1977. Presently, three companies supply natural gas on the territory of the municipality: Bulgargas EAD, Primagas AD and Varnagas AD.

Bulgargas EAD has been present on the Varna market since 1977. Bulgargas EAD delivers only gas to nine industrial customers located outside the area covered by the project.

Primagas AD has been selling natural gas to some industrial end-users in Varna located outside the area covered by the project.

Varnagas AD was established in 1997 and is a joint venture of Overgas Inc. AD and Varna municipality. The territory covered by the license of Varnagas is not gas supplied. Creating of preconditions for the construction of the gas distribution network began in 2004 by building a steel supplied gas pipeline, which starts from AGRS Varna, to the territory covered by the license of Varnagas AD and has total length around 11 km.

The marketing experts of Overgas Inc. AD, Varnagas AD and external companies conducted the marketing survey for gasification of Varna municipality. In the course of the research the following has been done:

- Detailed research of the combustion installations of the industrial and public and administrative users on the territory of Varna municipality in 2003 and 2004. The level of consumption of fuels and electricity, the type of installed equipment and the different users' opinion on natural gas use was determined on the basis of meetings held with representatives of all industrial, public and administrative buildings and larger commercial sites;
- The social survey on households conducted by GALLUP in 2001. This survey provided information on the overall opinion of the households regarding the gasification process;
- Inquiry covering 1420 households, carried out by marketing experts of Varnagas AD;
- Information on the boilers in use, provided by the supervisory agency for high-pressure steam installations and equipment.

Based on marketing research conducted by Overgas Inc. AD for the territory covered by the license of Varnagas AD, the structure of energy sources in the projected region during 2003 is as follows: 13.34% solid fuels, 27.59% liquid fuels and 59.07% electricity. The Energy

Consumption and fuel mix used in the industrial and public and administrative sectors has been identified after conducting individual inquiries with each user.

In the residential sector, only part of the households has been surveyed by questionnaires; the survey included the Odessos district and a part of Primorski district. In the territory covered by the license of Varnagas AD there are no central heating systems, and the local heating systems are out of operation due to the high price of liquid fuels and problems with the allocation of the thermal energy consumed. In the licensed region most of the homes are flats, which do not offer conditions for using solid fuels. Mostly electricity is used for heating and hot water in such flats.

Fuel	*Energy consumption in 2003*			
	Industrial	*Public and administrative*	*Households*	*Total*
Heavy fuel oil	36.18	84.42	0.00	120.60
Gas oil	146.65	402.07	75.42	624.14
Brown coal	0.00	0.00	41.21	41.21
Anthracite and black coal	0.00	0.00	25.36	25.36
Briquette	0.00	0.00	37.79	37.79
Wood	0.00	0.00	357.70	357.70
LPG	0.00	22.56	101.56	124.11
Electricity	7.20	112.48	2026.80	2146.48
Total	**190.03**	**621.53**	**2665.83**	**3477.39**

Table 1: *Energy consumption in 2003 of the end-users (regions not serviced by Overgas Inc. AD are excluded) covered by the project by fuels and by sectors according to the marketing survey, TJ*

Summary

Currently the energy sources used in the project area are electricity, fossil fuels rich in carbon and natural gas. Over the period under review until 2012 the intensity of the use of energy based on carbon is expected to decline due to the use of nuclear power, hydropower, low-carbon raw materials and increased efficiency of conversion.

3. GREENHOUSE GAS SOURCES AND PROJECT BOUNDARIES

3.1. Description of the Sources of GHG Emission under the Project

The Project includes the natural gas supply and its use by the end-users from the industrial, public and administrative, and residential sectors. This project aims to replace solid and liquid fuels by natural gas and to create 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 consumers of fuels. The substitution of 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 license of Varnagas AD in Varna municipality.

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.
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.

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

Losses occur during storage and transportation of solid and liquid fuels, as well as during low-voltage energy distribution. The losses 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.

3.2. 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 losses 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 losses during fuels' storage, transportation and supply.

The emissions from losses of natural gas from the gas distribution networks have been identified by applying the emission factors of IPCC for the East European Countries and on the basis of input data from the Operation of Gas Distribution Networks and Natural Gas Sales Departments of Overgas Inc. AD.

3.3. Direct off-site emissions

Any direct off-site emissions are caused by the generation of the replaced electricity. Bulgaria has the highest emission ratio per GHG per 1 kWh electricity among Central European countries due to the use of lignite coals by the thermal power plants. By using the SENTER tables on the emissions for substituted electricity, all related direct off-site emissions for electricity are taken into account.

Overgas will use up-to-date methods and materials in the construction of 4 bar gas distribution networks. This type of gas distribution networks does not have dismountable joints and the losses are insignificant. Emissions caused by losses of natural gas from the gas distribution networks have been excluded from the calculations since they are less than 0.22% (in ton carbon dioxide equivalents).

3.4. Indirect on-site and off-site emissions

The indirect on-site and off-site emissions may be characterized as follows:
- Emissions during the production and processing of fuels;
- Emissions during the production of metals, transport vehicles and tanks for transportation and storage of fuels;
- Emissions during transportation and disposal of fuel wastes.

The control on these emissions is beyond the scope of the project. According to the guidelines of SENTER "emissions related to activities to produce, transport or deliver the fuel "at the gate" are negligible. *(page 6, Senter operating guidelines, volume 2, item 1.3.3, 2004*).

3.5. Project boundaries

The project boundaries include combustion installations of the industrial, public and administrative, and residential end-users in Varna municipality, excluding the users connected to the grid before the starting date of the project. The implementation of the project involves replacing large electricity volumes in households. The project also covers the generation, transportation and distribution of this electricity. The emission factors are taken out of the

Senter Operational Guidelines for Project Design Documents of Joint Implementation Projects, vol. 1, Annex B and cover the optimization of the energy generation capacities within the period until 2012. Due to the insignificant losses during the transportation and delivery of solid and liquid fuels, the temporary warehouse facilities for storage and sale are not included in the project boundaries. The gas transmission network in construction is not included in the project boundaries due to its high quality and reliability. The quantity of methane losses calculated in t $_{CO2eqv.}$ as per IPCC is 0.22%. According to data from Overgas Inc. AD, the losses of natural gas suffered by companies- "operators" in 2003 and 2004 were less than 0.1%, and due to their negligible amount they have been excluded from the overall calculations.

The block-scheme of fuel delivery before and after implementation of the project with its main parts and connections are shown in figures 3a and 3b.

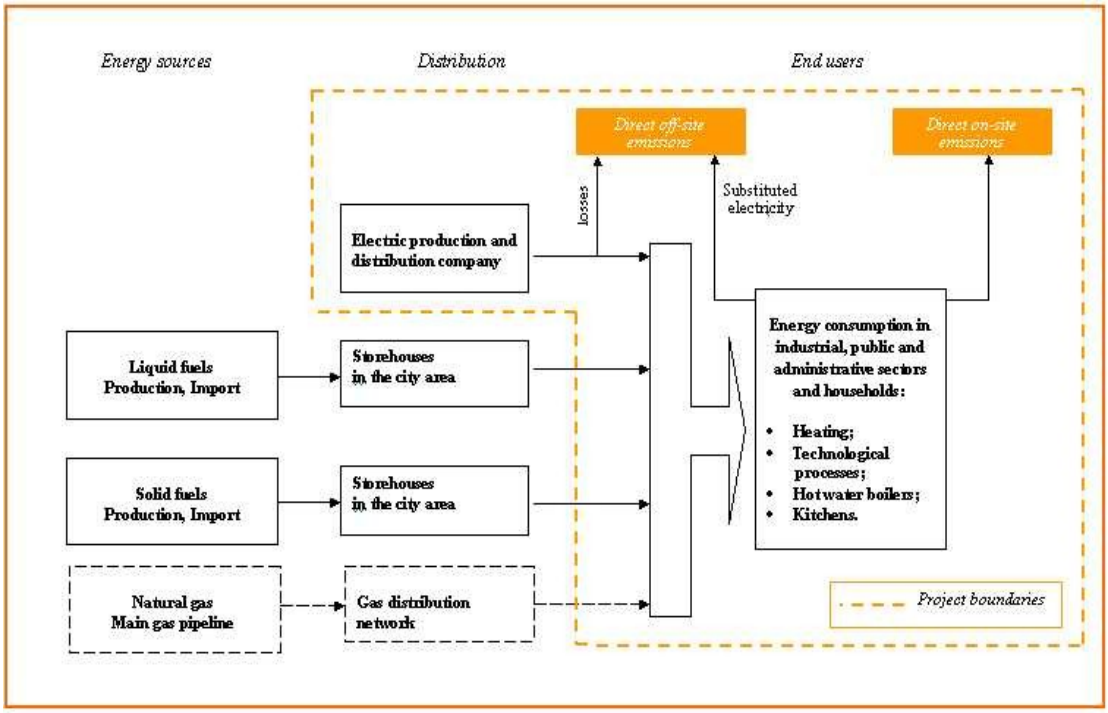

Figure 3a: Block-scheme of fuels delivery before gasification and project boundaries

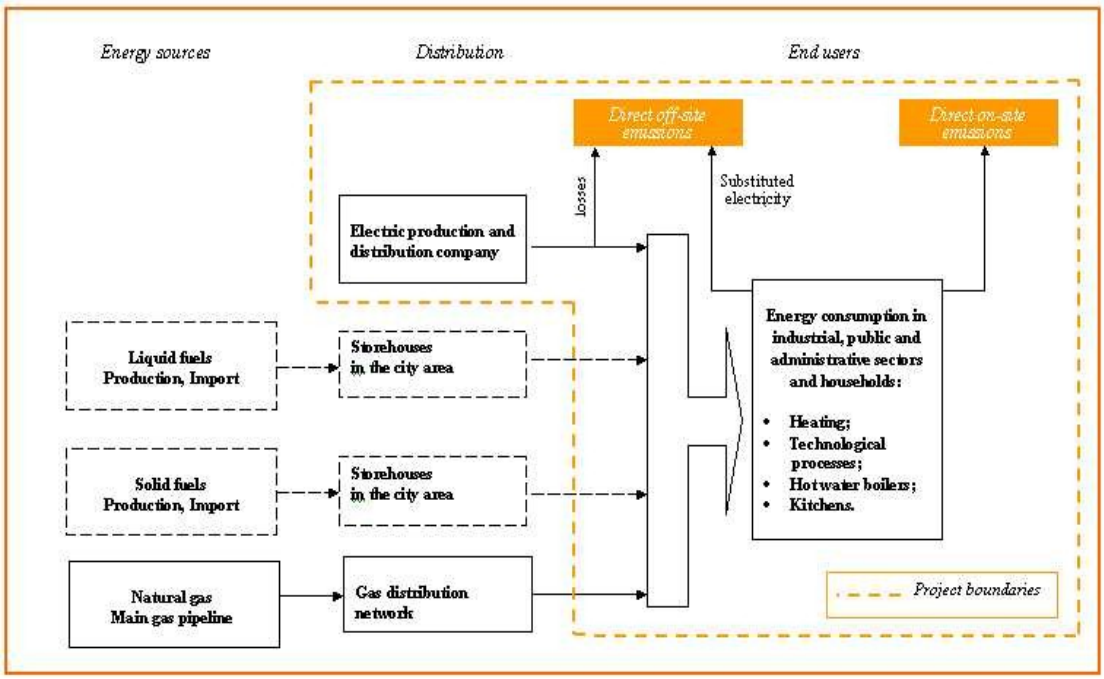

Figure 3b: Block-scheme of fuels delivery after gasification and project boundaries

4. KEY FACTORS INFLUENCING THE BASELINE AND THE PROJECT

The main purpose of the study of the key factors is to identify and analyze their impact on the baseline and project development.

4.1. External key factors

4.1.1. Legal factors

The legal and institutional framework for the energy sector in Bulgaria is set out in the Energy Act (amended as of March 5, 2004), Energy Efficiency Act (effective as of March 5, 2004) and the regulations for their application. These two fundamental Acts regulate public relations in the energy sector with regard to state governance, regulation and efficient use of energy and energy sources, as well as the rights and obligations of legal entities in conducting activities in production, import, export, transfer, distribution and sale of electricity, heating energy and natural gas, enhancing energy efficiency and encouraging the use of renewable energy sources.

The State Energy Regulatory Commission, in conformity with the Energy Act, has issued to Varnagas EAD license No Л-125-08/17.07.2003 for the activity "Natural gas distribution" for the territory of the districts of Odesos, Prirmosrki (including the vacation resorts St. Constantine and Elena, Zlatni Pyassatsi, Riviera), and the municipalities of Topoli, Kamenar, Zvezditsa, Kazashko and Konstantinovo belonging to Varna municipality.

The Government of the Republic of Bulgaria has concluded the negotiations with the EU regarding the harmonization of the issues under the Energy Chapter, thus bringing the legislation adjustment to an end.

Bulgaria has signed and ratified the major international treaties and conventions in the field of environment protection, including the Kyoto Protocol.

As far as environmental protection is concerned, the Environmental Protection Act update was approved in August 2004, and it entered into force at the beginning of this year. It establishes the legal framework for further progress in environmental impact assessment, access to information, and protection and control over industrial pollution.

4.1.2. Macro-economic factors

End energy consumption is a key macroeconomic factor that influences the baseline and the project. Energy intensity in Bulgaria measured as ton oil equivalent of 1000 USD/GDP[1] amounts to 1.57. This value is several times higher than those in the West European countries. This high consumption rate results from the large production drop in all economic sectors and the prolonged period during which the prices of energy sources did not correspond to their real cost.

The trends of the key macro-economic factors laid down in the forecasts and scenario for development of gasification in the region under review over the period 2003 – 2012 are as follows:

- Steady pace of economic development, including:
  - Implementing cautious and flexible fiscal policy;
  - Reducing the country's dependence on the IMF;
  - Accelerating of the structural reform;

[1] *Energy Strategy of the Republic of Bulgaria adopted by CM Decision dd. 11May 2002.*

Establishing a competitive market economy.

- Increase of the population income and more favorable conditions for consumer loans;
- Placing natural gas in a competitive environment to other energy sources by eliminating the direct and cross subsidies to these energy sources;
- Closing down Units 3 and 4 of Kozloduy Nuclear Power Plant by the end of 2006;
- Decreasing the energy efficiency of the economy and the consumption of electricity in the households.

Estimated macro-economic indicators of Bulgaria for 2007 (National Plan for Bulgaria's Economic Development by 2007, State Agency for Economic Analyses and Forecasts, April 2002)[2]:

GDP (real growth)	5.5%
Inflation rate	3.5%
Unemployment rate	10.0%
Savings /GDP	18.6%

The GDP growth has a direct impact on the growth of the end energy consumption in the country, including the use of natural gas.

The World Bank's Survey "Energy and Environment" indicates that Bulgarian households differ from households in other countries in Southeastern Europe in their predominant electricity consumption, including for heating purposes. The energy strategy of Bulgaria highlights this fact and underlines that not more than a fourth of the primary energy reaches the user as electricity.
Replacing electricity with natural gas whereby the efficiency of combustion installations is above 90% is a key step to improve energy efficiency and reduce the adverse impact of the energy on the environment.

4.1.3. Price factors

The following elements need to be taken into account and analyzed in this respect:

- Trends of the long-term development of prices and the methodologies for calculation of fuel prices;
- Trends in the behavior of the local currency with regard to the one related to the import of fuels.

The dynamics of the prices of the main energy sources for end energy use is a substantial factor for the development of gas supply, because the ratio of the prices of natural gas and the other energy sources determines the market demand for natural gas.

The forecast for the prices of energy sources is based on the following assumptions:

Liberalized liquid fuels market

The liquid fuels market in Bulgaria was liberalized in 1997. The domestic prices follow the trend in international prices of petroleum products and have been estimated depending on the fluctuations of the latter taking into account also national taxes and fees.

Regulated natural gas market

The Natural Gas Price Control Regulation adopted by Decree No. 131/15.06.2004 of the Council of Ministers replaces the Regulation on formation and application of natural gas prices and tariffs as of 01.04.2002. All gas transmission and distribution companies apply the natural gas prices and tariffs determined in accordance with the Regulation.

[2] *At present, long-term forecasts for macroeconomic indicators in Bulgaria are done only at the central government level.*

Natural gas prices, when natural gas is sold by gas distribution companies, include the following components:

- Natural gas price at the input of the gas transmission network;
- Price for natural gas transfer along the gas transmission network;
- Price for natural gas transfer along the respective gas distribution network for the respective user group.

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 20% lower than the price per 1 KWh energy generated from 3.5% S heavy fuel oil, which is the main energy source used in the industrial sector. The natural gas price is 66% lower compared to the industrial gas oil used in the public and administrative and trade sectors. For households, the natural gas price is 61% lower than the electricity price. *(Appendix 6)*

4.1.4. Market factors

The consumer potential of the natural gas market on the territory of Varna municipality is a basic market factor, which is affected by:

- availability of consumer need and amount of market demand for natural gas in a given territory;
- availability and supply of energy sources alternative to natural gas;
- availability and supply of natural gas in the Republic of Bulgaria;
- the approximate estimated volume of natural gas sales assessed in two aspects – first, substituting conventional energy sources for natural gas (such as heavy fuel oil, electricity, solid fuel) and, second, occupying the free share on the regional market of energy sources;
- natural gas price levels compared to other energy sources (*discussed under item 4.1.3. "Price Factors"*);
- ability of the population to pay – considered in two aspects: *(discussed under item 4.1.6. "Social-demographic")*
  - flexibility of natural gas consumption when the supply price rises above certain level;
  - possibility to purchase and install gas equipment.
- Objective assessment of one's own potential and the potential of the competition.

4.1.5. Political factors

In the early 1990-s the country's transition to democracy and market-oriented economy was characterized by a slow pace of the structural reforms and uncertain stabilization policy. After the economic and political collapse in 1997 the pursuing of a good macro-economic policy and a large-scale programme for structural reforms contributed to a rapid positive turn in Bulgaria's economy. In view of the expected accession of Bulgaria to the EU the country will maintain its integration policy, which along with the economic recovery will gradually achieve higher income and better living conditions as a result of the expected economic revival.

4.1.6. Social and Demographic factors

This group of factors is of substantial importance because they are directly related to the pace of implementation of the project for gasification in Varna municipality in the residential sector. The impact of these factors is directly dependent on:

- Enhancing the competitiveness of the regional economy;
- Improvement of the basic infrastructure and protection of the environment;
- Human resources development – improving the living standard of the households in the territory covered by the investment project; improvement of the structure and composition of the population, reduction of the unemployment rate, increasing the average income and the purchasing capacity;
- Balanced and sustainable economic development of the region – establishing conditions for development and support of small and medium enterprises (SMEs), creating conditions for attraction of foreign investments, mitigation of the differences among regions and social groups, accompanied by general improvement of the living standard.

Data from the Unified System for National Registration and Administrative Services indicate that the population of Varna municipality as at 14.12.2004 is 352 161 residents, or 4.2% of the country's population

The Municipality has a high population density of 1488 people/sq. m. The municipality ranks second in the country on the proportion of people who have higher than secondary education (22.6). 72.7% of the workforce of the region is concentrated on the territory of the municipality.

The unemployment rate as of 2002 is 9.56% compared to an average of 16.30% for the country. Over the projected period, the private sector is expected to create new jobs and to attract the workforce released from liquidated and/or restructured state-owned enterprises. This will reduce the unemployment rate considerably to one of the lowest in Bulgaria and it will also improve the purchasing capacity of the users.

4.1.7. Economic factors

The Municipality of Varna has a huge economic potential and well-developed infrastructure. The economic structure is highly diversified.

In 2002, 6% of all economic entities in Bulgaria are registered at the territory of the municipality. They own 5% of the fixed assets and generate 7% of the net sales revenue in the country.

The net sales revenue is showing a steady growth. The increase in 2001 compared to 2000 was 18.05%, and it was 31.22% for 2002 respectively.

The economy of Varna region is well represented at national level with GDP constituting 5.4% of the national GDP. The private sector has more than 50% share in the economy, the largest being in the processing industry. The region ranks third for the country by "foreign investments by industries per person". The economic profile of Varna region is characterized as follows: industry - 40%; transport - 25%; tourism - 10%; trade - 15% and construction - 10%. *(http://www.ttz-varna.com)*

These data confirm the projections of sustainable development of the region, the employment provided to the population and the income stability as a prerequisite for the estimated growth in energy consumption.

4.1.8. Environmental factors

- ***Emissions of greenhouse gases lower than the quantities defined as per the commitments undertaken by Bulgaria under the international agreements;***

According to the Second National Action Plan on Climate Changes 2005-2008, Bulgaria will not face difficulties with the implementation of the requirements of the UN Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol for limiting greenhouse gases emissions to up to 130 475 thousands $tCO_{2eqv.}$ per year over the period 2008-2012[3].

- ***Implementation of the regional sustainable development and energy efficiency plans and programs***

The implementation of the project Reduction of Greenhouse Gases by Gasification in Varna municipality is in compliance with the sustainable development plan and the Municipal energy efficiency program.

4.2. Internal key factors

4.2.1. Technical factors

- ***Factors related to engineering activities***

These factors are related to the complexity of the engineering implementation of the project, unavailability of preliminary and accurate information on the terrain cadastre, as well as unavailability of modern technologies for engineering activities, and high operating costs.

Design work is done using specialized software for dimensioning of the facilities and for optimization and analysis of gas transmission networks. The state-of-the-art CAD systems being used have an option for integration with geographic information systems (GIS). Overgas Engineering AD uses modern technologies and equipment for laying and welding of steel and polyethylene gas pipelines. The materials and equipment used meet the requirements set by the Bulgarian and European standards. They are supplied by leading companies in the sector, which have ISO 9000 certification.

- ***Factors related to the construction and assembly work***

This group of factors takes into account construction and assembly risks, commissioning risk, and a possible delay in commissioning, and risk connected with obtaining permits for starting regular operation of the site.

Among the evidence that implementation-related risks do not jeopardize the project implementation are the:

- High professional level of the preliminary natural gas market studies at national and local level;
- Quality of service delivered;
- Precision and completion at a high technological level of the detailed designs and the construction of city networks;
- Experience gathered.

The gasification of certain boiler stations, public and business buildings, as well as houses, is a matter of conventional technologies that are well-known and already proven over time, whereby such risks are practically not present in the activities of the gas distribution companies and Overgas.

The optimal organization and application of contemporary technologies for trenchless laying of the gas distribution network allow for construction even in densely populated areas without disruption of the daily routine of the population and without affecting other underground

[3] *Second National Action Plan on Climate Changes 2005-2008*

communications. Environmental protection and the reconstruction of affected terrains are compulsory components of construction and assembly works.

4.2.2. Financial factors

The need to ensure large initial investments is a characteristic feature of gasification projects for populated areas. Reinvestment funds can be accumulated only after 4 to 5 years of operation of the gas distribution network. This is why obtaining the consent of the Dutch Government and the approval of the Bulgarian Ministry of Environment and Water is of substantial importance for the launching of the project for gasification of Varna as a Joint Implementation (JI) project. Recognizing the project as a JI will facilitate the obtaining of bank loans at favorable terms.

Summary

The project complies with the strategy of the Bulgarian government for enhancing the energy efficiency in all consumer sectors. The GDP growth has a direct impact on the increase of the total quantity of energy consumption in the country, including the consumption of natural gas.
The local authorities support the project. Therefore, all prerequisites of market nature in support of the project are in place.
The required budget for the project implementation will be available with the support of funds from emission reduction sales and the support of the Dutch Government. Over the whole period of the project, natural gas will be a product with an attractive price compared to other energy sources.
Marketing studies show that should the opportunity be in place, all industrial and public and administrative sites as well as a large part of households will switch to natural gas.

5. ADDITIONALITY

The project "Reduction of greenhouse gases by gasification in Varna municipality" is additional to any scenario that would otherwise occur. This statement is proven by the three methods for additionality testing that have been adopted by SenterNovem. The most probable and the only realistic alternative 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.
This scenario is the same "baseline scenario" used elsewhere throughout this PDD. This baseline scenario is equivalent to the "business as usual" scenario. The three test methods are:

> ***Test 1:*** The project is not business-as-usual because an alternative exists that is more economically attractive
> ***Test 2:*** The project is not business-as-usual because without the sales of carbon credits the project is not economically viable
> ***Test 3:*** The project is not business-as-usual because several significant barriers exist for the project

When evaluating the project, two aspects should be addressed: not only the business aspect of the operator Varnagas AD gas distribution company but also the investments at the end-users. Similar to other projects for fuel switch, the transition costs are an important factor and financial and psychological barrier.

Test 1: Avoidance of the fuel switch and continued use of the carbon-rich electricity, gas oil, carbon-rich coals, wood and heavy fuel oil, is economically attractive since no additional investments in appliances, installations, and infrastructure are needed. Especially on the short term (up to five years) in which end-users will make their decisions, the switch to natural gas is very expensive. Financial profits, if any, will occur only on the long term.

Test 2 is also not really applicable since it also disregards all efforts and investments by the end-users. To assist the end-users in their decisions the supplier Overgas Inc. AD transfers the ERUPT 5 revenues to a lower gas price to the end-users. The payback period of the end-users investments is perceived as unattractive. However, the lower gas price, due to ERUPT 5, will reduce the payback time to more acceptable period for large groups of end-users.

The present situation in Varna demonstrates the need to support the end users financially to switch to natural gas.

Through this transfer, the *direct* financial impact of ERUPT 5 revenues on the business of Overgas Inc. AD is negligible. The *secondary* impact is enormous due to the access obtained from large groups of end-users, thereby improving the economy of the whole project.

Due to the nature of the Project, test 3 will prove most clearly the additionality of the project.

Test 3 is entirely appropriate to the Overgas Inc. AD project. The main barriers are reviewed below. The Dutch Government participation in the project and the funds expected from ERUPT 5 will be a crucial impetus for initiating the project and will help speed up its development pace and the achieving of the projected results.

➢ ***Financial additionality***

Three scenarios have been examined:

1. ***Low gas price:*** The calculations of IRR are made under a financial plan where most ERUPT 5 revenues are transferred to the end-users by lowering the gas prices (describing the expected situation).
2. ***Low project cost:*** A financial plan with the ERUPT 5 revenues invested directly in the project (describing a virtual situation).
3. ***No ERUPT 5:*** A financial plan without ERUPT 5 revenues (describing a virtual situation).

The calculation method for IRR and NPV includes applying a 10 % discount rate to all negative cash flows (the investments in the Gas Distribution Networks and in the required working capital, financial costs for servicing the loan and current expenditures for the distribution of natural gas as an activity) and positive cash flows (revenue from sales of natural gas, from connection fees and from delivery of maintenance and repair services). The financing of the investments will be according to the description in point 1.3.4. "Related financial commitments". The principals of the loans have been excluded from the cash flow because otherwise they would have been included twice in the assessment. All estimates are on the basis of 2004 stop assumptions (given that the inflation component is not taken into account in the prices and costs assessment) and VAT is excluded.
The revenues have been planned on the basis of prices and sales, which have been assessed on the basis of a profound market study for stage-by-stage covering of the market of potential natural gas users. The current costs are projected on the basis of the 13 years of experience and statistics of Overgas Inc. AD in 26 local city gas distribution companies and take into account all costs by economic components: materials, services, salaries and other costs. The detailed projections of the revenue and costs will be submitted to SenterNovem under the Business Plan of the project. Table 2 shows the NPV and IRR under the different scenarios.

Scenario	*IRR (%)*	*NPV (M€) (2005 – 2014 ; interest rate 10 %)*
Low gas price	12.83	1.178
Low project costs	14.86	2.085
No ERUPT 5	12.60	1.144

Table 2: Impact of ERUPT 5 revenues on the project.

In the first approach, comparing the "No ERUPT 5 revenues" and "Low project cost" scenarios, the IRR would improve from 12.83% to 14.86%. The NPV would increase from 1.178 to 2.085. IRR and NPV increase considerably thus clearly demonstrating the financial additionality of the ERUPT 5 revenues.

In the second approach, it is decided that the ERUPT 5 revenues are to be used to lower the gas prices, allowing the end-users to have an essential profit from their investments in natural gas appliances and installations. In this approach, the additionality effect is shifted from the project to the end-users. When compared, the "low gas price" and the "no ERUPT 5" scenarios show only marginal differences in IRR and NPV.

The scenario "no ERUPT 5" is virtual. In practice, the project cannot develop without being financed by emission reduction sales. The planned positive cash flows will not be reached because of absence of large groups of end-users.

The ERUPT 5 revenues are in reality used to lower the natural gas price for the end-users, providing them with an essential financial incentive to switch to natural gas.

- ***Significant barriers***

The earliest attempts to initiate the large scale gasification in Varna were without results. Assistance of the ERUPT 5 revenues will have a strong and clearly defined positive influence on the project. Significant barriers exist for further gasification in Varna. The barriers are legal, technical, financial, institutional, social and cultural. The ERUPT 5 is not only essential for its financial revenues for the project but also adds an essential impact on overcoming subjective barriers.

- ***Legal barriers***

Regulations are important to ensure the safe use of energy. 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.

- ***Technical***

The use of natural gas is new to nearly all future end-users on the territory of license of Varnagas AD. Overgas Inc. AD has to invest in training and education of the installer. 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 restructuring of the combustion installations are not readily available to the installers and end-users. A program and measures for mass supply of varied and state-of-art technical options are planned under this project.

The skills to install natural gas pipes, flue gas chimneys and appliances are only latently available. In this project, large-scale training and education of the installers has to overcome this barrier. Therefore, it is necessary to devise and implement specialized training and retraining programs.

The technology is new to the territory of Varna project and needs to be adapted to the typical Varna situation, for example, for the use of natural gas in the existing large and compact apartment buildings. The installation of a full 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 perceived safety risks, not only by the potential end-users, but also by the local authorities. In this project an intensive public relation campaign will be needed to overcome this barrier.

- ***Investment barriers***

The launching of a wide scale infrastructure project such as the Gasification Project in Varna municipality requires huge investments.
The replacement of energy sources requires the purchasing of natural gas equipment by the end-users. The latter should also adjust their installations to natural gas transportation or build entirely new installations and ensure proper ventilation to guarantee the safe use of natural gas according to existing regulations.

- ***Financial barriers***

Financing of infrastructural projects by private banking in Bulgaria is troublesome by the perception of high risks. Having the trust, and the additional financial revenues, of the Dutch

government in this ERUPT 5 projects; private banks will be less reluctant in taking their share in financing the project.

One of the most important conditions for the project implementation is to provide its financing. The revenues from emission reduction sales are crucial to the provision of initial project funding.

Revenues from emission reduction sales will facilitate the arrangement of bank loans. The project foresees a 10 % maximum interest rate due to the cautiousness of European banks in supporting investment projects in Bulgaria.

The use of natural gas requires significant investments by the end-users. The lower gas price, due to the ERUPT 5 revenues, will support the potential end-users in their decision to switch to natural gas. In the first three years, negative cash flow prevails over positive cash flow in Varnagas AD. In this context, revenue under ERUPT 5 will be important for strengthening the positive cash flow, in particular over the first years of large investment costs.

- ***Institutional barriers***

Apart from the ERUPT 5 revenues, there are no subsidies available. The Bulgarian Government has a policy to support the fuel switch. However, this support does not include any financial incentives: neither for Overgas Inc. AD, nor for the potential end-users.

- ***Cultural barriers***

The current infrastructure is dedicated to the use of conventional fossil fuels. Stakeholders are familiar with all aspects of the use of oil, coal and LPG: prices, availability, appliances, risks and precautions. The awareness of the qualities of the utilization of natural gas is still nascent in most stakeholders.
End-users consider the use of conventional fossil fuels as standard practice. The utilization of natural gas is still perceived by most stakeholders as new and risky. For nearly all end-users, the utilization of natural gas will be "a first of a kind" experience.

Summary

Significant economic, social and technological barriers have prevented up to now the large-scale switch to the utilization of natural gas in the Varna municipality. The revenues of ERUPT 5 will catalyze, and thereby realize, the fuel switch, in the first place by the financial revenues but also by the momentum induced. The ERUPT 5 revenues provide the catalyst for the fuel switch. The project "Reduction of greenhouse gases by gasification in Varna municipality" is not business as usual, which underlines its additionality without any doubt.

6. IDENTIFICATION OF THE MOST LIKELY BASELINE AND THE ASSOCIATED GHG EMISSIONS

The change in the greenhouse gases emissions depends directly on the level of end energy consumption, the profile of the use of energy sources, and the change in the specific energy-intensiveness per unit of production.

The end energy consumption, including that of natural gas, is influenced mainly by economic and social-demographic factors. The structure of the used energy sources depends on the purchasing capacity of the users and the technological level of the energy installations. The reduction of the specific energy-intensiveness depends on the penetration of the best available technologies (BAT) in the energy sector and the renovation of the energy equipment at the end users.

6.1. Baseline selection, specification and calculation of the emissions

The energy end consumption (EEC) outlook for the period ending 2012 in Varna municipality is made after analyzing the US Department of Energy forecast on GDP and EEC in Eastern European countries[4], the short-term outlook of the Agency for Economic Analysis and Forecasting (AEAF) for Bulgarian economy[5] and data from the Ministry of Energy and Energy Resources (MEER) on the economic situation of the Northeast planning region. [6]

Table 3 presents the forecasts of the US Department of Energy for change in GDP and end energy consumption (EEC) in three scenarios for Eastern European countries. A GDP growth of 2.8 to 4.8% is foreseen for different economic development scenarios. According to AEAF figures, the real GDP growth in Bulgaria over the past two years was 4.3% and 5.3%, respectively. Bulgaria's projected GDP growth in the course of the next few years is above the 4.5% mark, which is in accord with the global economic development forecast and respective EEC growth of 2.1%.

	Indicator	History			Forecasts				Average annual growth
		1990	2000	2001	2010	2015	2020	2025	
Low growth	GDP, 10^6USD	353	379	389	500	578	668	763	**2.8**
	EEC, 10^6toe	393	285	287	306	319	339	339	**0.7**
Reference growth	GDP, 10^6USD	353	379	389	550	667	810	971	**3.9**
	EEC, 10^6toe	393	285	287	323	247	383	399	**1.4**
High growth	GDP, 10^6USD	353	379	389	595	757	963	1212	**4.8**
	EEC, 10^6toe	393	285	287	340	378	431	469	**2.1**

[4] *International Energy Outlook 2004*
[5] *The Bulgarian Economy: Analysis and Outlook, October 2004, AEAF*
[6] *http://www.mi.government.bg/ind/regpol/region.html?br_id=147*

Table 3: Forecast of the GDP and EEC for Eastern European countries[7]

According to MEER data on the economic situation of the Northeast region of Bulgaria, the economic indicators for the Municipality of Varna are higher than the country average.

Demographic forecasts for the country foresee a population decrease of 0.2 to 0.6% per year. Over the past years Varna witnessed a population increase as a result of migration processes related to the growth in business and tourism in Varna municipality. At the same time, there have been projections for low inflation rate levels (for the period 2003 - 2007 – 3.9%), an increase in the income level of the population by 2.5% per year until 2012, and a positive development in consumer lending terms. It is assumed that GDP and inflation levels will also continue to be stable after 2007.[8] These data give grounds for selecting limiting values of the end energy consumption growth for Varna Municipality using the estimates under the reference and high scenarios for end energy consumption growth.

The change in end energy consumption for the Municipality of Varna is projected according to two scenarios. (*Table 4*) In the first scenario, the end energy consumption for the period 2001-2020 has a projected growth of 1.70%, which is close to the average EEC growth scenario for Bulgaria. The second scenario foresees an annual EEC growth of 1.32%, with growth in the industrial sector of 1.1%, 2.2% in the public and administrative sector, and 1.4% in the household sector. A starting point in developing the scenarios of energy consumption in the region is the 2003 energy consumption in the region covered by the license.

Sectors	*Industrial sector*	*Public and administrative sector*	*Residential sector*	*Total*
Scenario 1	1.4%	2.50%	1.60%	1.70%
Scenario 2	1.1%	2.20%	1.21%	1.32%

Table 4: Average annual EEU growth by sectors, in % (2004 – 2013)

The change in the End Energy Consumption in the region covered by the license under the two scenarios of energy consumption development is shown in *Figure 4.*

For calculating the baseline emissions we assume Scenario 2, which corresponds to a more conservative growth of end energy consumption.

The present situation shows that the pace of construction of the gas distribution network and connecting users without sufficient financial backup is much slower than the potential pace, not reaching even their most pessimistic forecasts.

There are no components of the gas transmission network and connecting gas pipelines on the territory of the license of Varnagas AD. Without the activities of Varnagas AD, the potential users do not have a chance to use natural gas from Bulgargas EAD or other suppliers.

[7] *International Energy Outlook 2004*
[8] *Year of expected Bulgarian EU accession.*

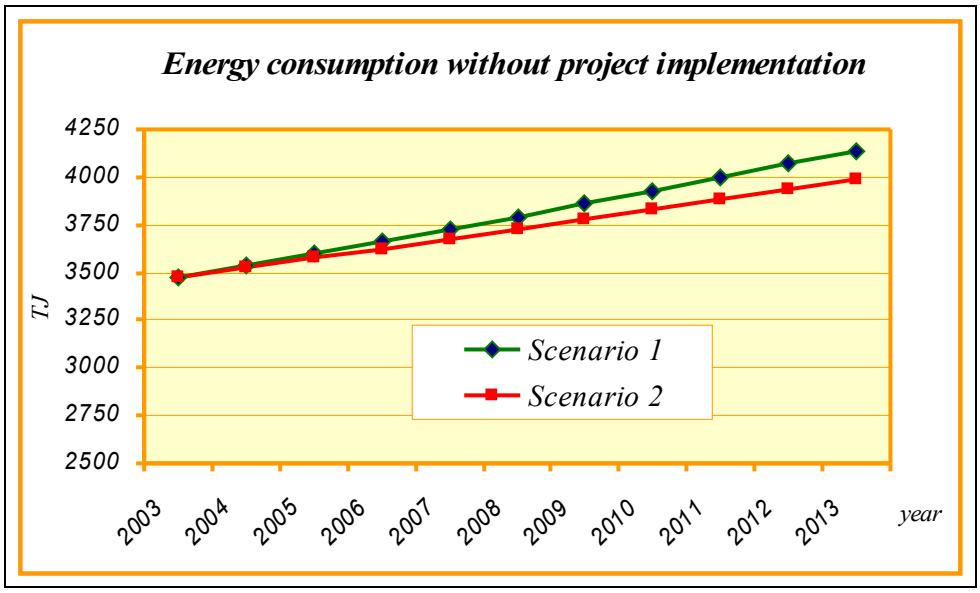

Figure 4: On-site energy consumption without project implementation

Table 5 presents the baseline forecast for energy consumption by energy sources, including losses during transport, storage and sales.

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Heavy fuel oil	121	123	125	128	130	132	135	137	140	143
Gas oil	624	636	647	659	671	683	696	709	722	735
Brown coal	41	42	42	43	43	44	44	45	45	46
Anthracite and black coal	25	26	26	26	27	27	27	28	28	28
Briquettes	38	38	39	39	40	40	41	41	42	42
Wood and wood waste	358	362	366	371	375	380	384	389	394	399
LPG	124	126	128	129	131	133	135	137	139	141
Electricity	2146	2174	2201	2229	2257	2285	2314	2344	2373	2403
Natural gas	0	0	0	0	0	0	0	0	0	0
Total	3477	3525	3574	3624	3674	3725	3776	3829	3882	3936

Table 5: Energy consumption by energy sources without project implementation, Baseline scenario 2, in TJ

6.2. Indication of the emissions in the absence of project activities - baseline

The baseline represents the greenhouse gases amount without project implementation for each year up to 2012 inclusive. Using the emission factors shown in *Table 6* the calculation of greenhouse gas emissions is made.

Energy source	*Emission factors, tco_2eqv*
Heavy fuel oil	76.6
Gas oil	73.3
Brown coal	95.6
Wood and wood waste	0.0
Anthracite and black coal	101.3
Briquettes	95.6
LPG	62.4
Natural gas	55.82

**The data are taken from Bulgarian GHG Inventory 2002, Annex III.*

Table 6: Carbon dioxide emission factors, ton CO_2 / TJ

In determining the total quantity of greenhouse gas emissions without implementation of the project, calculations of the greenhouse gas emissions are made by fuels for each sector, by multiplying the quantity of fuel used by the emission factor of the fuel for the respective greenhouse gas. The values obtained are converted into $t_{CO2eqv.}$ and summed up. The emission factors were taken from the Bulgarian Greenhouse Gases Inventory 2002 Report, Annex III. The emissions of methane and dinitrogen oxide were not calculated under the project due to their small values.

The growth of energy consumption during the concerned period leads to an increase of emissions released. Electricity has different emission factors for different years to reflect efficiency increases of the electricity generating installations and reduction of transmission losses. (Table 7) The carbon dioxide emission factors used for electricity are taken from SenterNovem Guidelines, as there is no approved CDM methodology applicable for the project.

	2003	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*
Bulgaria	1002	979	957	934	912	890	867	845	822	800

Table 7: Baseline carbon dioxide emission factors for JI projects reducing electricity consumption (in gCO_2/kWh)[9]

It is envisaged that the efficiency of the power generating installations in Bulgaria will gradually draw level with those in the EU by 2020.

[9] *Operational guidelines for PDD of JI projects,Vol.1, Annex B, SenterNovem, 2004*

The total quantity of greenhouse gas emissions for the observed period is shown in *Table 8.*

	2003	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*
Baseline Greenhouse gas emissions	670290	665176	660445	654875	649692	644280	637991	632098	625301	618905

Table 8: *Greenhouse gas emissions, Baseline, ton $CO_{2\ eqv}$*

Summary

The construction of the baseline is based on the following trends:

- *Energy consumption growth follows the economic growth rate;*
- *Gradual decrease of the carbon dioxide emission factor for reducing electricity consumption during the observed period according to SenterNovem data;*
- *Constant level of the carbon dioxide emission factor for all other energy sources.*

7. ESTIMATION OF PROJECT EMISSIONS

7.1. Prognoses of natural gas annual consumption

Natural gas market is defined as a combination of:

- End-users;
- Relationships established between the natural gas distributor and consumers in respect to satisfying the specific energy needs (quantity, transmitted energy, access, terms, price, service quality, etc.)
- Specifics of the relationship with the competitors-distributors of other energy sources.

➢ ***Sources used for assessing the natural gas market in Varna municipality***

The assessment of the natural gas market is based on data from the inquiries in the industrial and public and administrative sectors carried out by marketing experts of Varnagas AD and Overgas Inc. AD, and digital model of Varna municipality and its administrative and territorial planning to town sections.

The following indicators have been used in determining the end energy consumption:

- Demographic data about Varna Municipality and the territory of the license (population and population growth: education, age structure, etc.);
- Characteristics and prices of real estate property;
- Consumption and increase of consumption of electricity;
- Income – level, structure and trends;
- Amounts and dynamics of the investments.

Analyses were based on:

- The installation capacities in the heating sources of the industrial and public and administrative sectors;
- Dynamics of the energy consumption by the users for the last three years and trends of development;
- The existing potential energy consumption in the three sectors and opportunity for switch to natural gas as a main energy source;
- Expected level of individual energy consumption per household;
- The penetration rate of the household market;
- Development of the housing fund;
- Gasification scope;
- Information obtained regarding Applications and Accession Agreements.

7.2. Description of the emissions calculation method

➢ ***Description of factors used for estimation of project emissions***

The total project emissions are influenced by the following factors:

- End energy consumption growth rate;
- Energy efficiency of the combustion installations before and after the gasification;
- Carbon dioxide emission factor of the substituted fuels.

All calculations for the project emissions are specified by the end-user sectors.

➢ ***Input data***

The energy consumption and the fuel mix in Varna municipality by types of energy sources in 2003 are taken as the departing point of the prognosis of the energy consumption. (*Table 1, item 2 of PDD)*

The prognoses of energy consumption by sectors with the project implementation are the accepted one in Scenario 2 *(item 6 of PDD)* in the calculation of baseline energy consumption and emissions. It's expected that the annual growth rates are constant over the whole project period.

For calculation purposes the *Operating energy efficiency factors by sectors and fuels – Table 9* and *Conversion factor for converting energy sources into natural gas* in sm^3/t. in *Table 10* are used.

	Industrial	*Public and Administrative*	*Households*
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 and wood waste	0.65	0.65	0.65
Anthracite and black coal	not used	not used	0.65
Briquettes	not used	not used	0.65
LPG	0.90	0.90	0.89
Electricity	0.98	0.98	0.98
Natural gas	0.90	0.90	0.90

Table 9: Energy efficiency factors by sectors and types of energy sources

The combustion installations of the end-users have more than 400 boilers, which differ in type, output and depreciation rate.

Heavy fuel oil
According to the available documentation of the appliance manufacturers the energy efficiency factors of new boilers in big industrial companies and small heating plants using heavy fuel oil is 0.88 ± 0.02.
Field studies in relation to projects PHARE BG 9107-03-14 and PSO BG-4-4-99 indicated a real operating energy efficiency factors of existing combustion installations on heavy fuel oil of 0.80 for small boilers of KM12 type and 0.81 for the big boilers of the VK type (VK – water heating boiler). In view of the fact that the greater part of the consumed quantity of heavy fuel oil is used in small boilers, an energy efficiency is 0.80 for combustion installations on heavy fuel oil in the industrial sector and public and administrative sector are taken in the calculations.

Gas oil – according to producers' catalogues the water heating and steam boilers of the KVN, ON and PKN type produced in Bulgaria have energy efficiency factors between 0.87-0.89 [10]. As per the questionnaires of consumers these energy efficiency factors have lower values depending on the operational state of their combustion installations[11]. Due to this the energy

[10] *Catalogues of Boiler Construction AD, Sofia*
[11] *Questionnaires to end-users*

efficiency factor of the boilers using gas oil in the industrial and public and administrative sectors is assumed to be 0.88 and 0.80 in the household sector.

Solid fuels (coal, briquettes and wood) – the installed boilers on solid fuels in the industrial sector are of old types, produced by the following enterprises: "Racho Kovacha" Gabrovo, "Kotlostroene" Varna, "Promishlena energetika" Varna and Vratsa. They are no longer produced. The efficiency factor for fire-grate boilers using solid fuels as described in reference books and technical literature [12] [13] [14], ranges between 0.55-0.77. The maximum efficiency factor for boilers in the industrial and public and administrative sectors is assumed to be 0.70. The efficiency factor in the household sector is very low 0.65.

Natural gas - in all combustion installations after gasification an efficiency factor 0.90 is assumed. On the basis of these data the conversion factors for different fuels in different sectors are estimated and represented in *Table 10.* The utilization of high efficient and condensing appliances may result in efficiencies of 1.00 up to 1.06.

Electricity – for the electricity used for cooking, for hot water and heating energy efficiency factor 0.98 is assumed.

For the calculation of the conversion efficiency factor fuels the following formula is used:

$$K_{fuel} = \frac{(LHV_{fuel}, TJ/t) * Eff.\ factor_{fuel}}{(LHV_{natural\ gas}, TJ/1000m^3) * Eff.\ factor_{natural\ gas.}}$$

Where:

K_{fuel}	Conversion factor for the relevant fuel;
LHV_{fuel}, [TJ/t]	Low heating value of the substituted fuel;
Eff. $factor_{fuel}$	Energy efficiency factors of the combustion installation before gasification;
$LHV_{natural\ gas}$, [TJ/1000m^3]	Low heating value of natural gas;
Eff. $factor_{natural\ gas.}$	Energy efficiency factors of the combustion installation after gasification.

	Dimension	Industrial sector	Public and administrative sector	Household
$K_{heavy\ fuel\ oil}$	1000 sm^3/t	1.070	1.070	-
$K_{Gas\ oil}$	1000 sm^3/t	1.227	1.227	1.115
$K_{brown\ coal}$	1000 sm^3/t	0.263	0.263	0.244
$K_{Anthracite\ and\ black\ coal}$	1000 sm^3/t	-	-	0.551
$K_{Briquette}$	1000 sm^3/t	-	-	0.411
K_{Wood}	1000 sm^3/t	0.216	0.216	0.216
K_{LPG}	1000 sm^3/t	1.401	1.401	1.386
$K_{Electricity}$	1000 sm^3/GWh	117.37	117.37	117.37

Table 10: Conversion factor for converting energy sources into natural gas by sectors

[12] *Heating, air conditioning and heat installations, I. V. Vuchev, N.D. Minchev. DI "Technika", Sofia, 1962.*

[13] *Heating, air conditioning and heat installations, Prof. V. I. Ivanov, Dr. B.M. Krapchev, DI "Technika",Sofia , 1978.*

[14] *Reference book on heating, ventilation and air conditioning, Part 2, Heating and heat installation, footnote of Prof. Dr. S, Stamov, "Technika", Sofia, 1991*

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

- Determination of the energy sources' amounts replaced by natural gas by sort of the fuel and by sectors;
- Calculation of the quantity of natural gas equivalent to each replaced energy sources, by multiplying the quantity of replaced fuel by conversion efficiency factor from *Table 10;*
- Calculation of 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 from the end-users' combustion installations.

During the observed 10-year period, project provides for gradually replace 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 after the distribution mains from the GDS are constructed.

In the residential sector first the more expensive energy sources, namely electricity and industrial gas oil, are replaced. Due to its low price wood is planned to remain in use as one of the main energy sources in summerhouse zones and in regions where most of the homes are houses, and not flats.

The data on the replacement rates of the energy sources used in Varna municipality are presented in *Table 11.*

	2004	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*
Heavy fuel oil	123	98	52	31	18	0	0	0	0
Gas oil	635	570	490	409	343	283	189	163	153
Brown coal	42	42	39	24	19	13	8	3	2
Anthracite and black coal	26	26	25	19	15	8	4	1	1
Briquettes	38	38	38	31	27	17	12	9	5
Wood	362	366	358	341	335	315	294	275	265
LPG	126	125	113	108	85	60	36	30	20
Electricity	2173	2189	2178	2165	2135	2092	2027	1930	1840
Natural gas	0	115	317	514	710	939	1200	1415	1597
Total	3525	3570	3609	3642	3686	3725	3771	3824	3881

Table 11: Distribution of used energy sources upon project implementation, in TJ

The suggested scenario for project development is a conservative one for the following reasons:

- A conservative scenario has been assumed for the increase of the end energy consumption.
- The forecasts for gasification until 2012 do not include the resorts of St. Constantine and Elena, Riviera and Zlatni Pyassatsi, and a part of the urbanized areas.
- A low coverage (29%) of penetration in the residential sector has been assumed. The potential number of residential users within the territory of the project is 75 700, and the project foresees switching to natural gas of 21 900 households.

7.3. Estimation of the total projected emissions

Total project emissions include direct on-site and off-site emissions. Indirect on-site and off-site emissions are below 1% and are excluded of the calculation.

For the calculation of direct project emissions are determined and reported:

- the released emissions from burning different fuels in the combustion installations of end-users by using the carbon dioxide emission factors, *Table 6*
- reduced emissions resulting from less fuel consumption due to increased energy efficiency calculated by conversion factors *Table 10*;
- reduced emissions resulting from eliminating the losses during transportation and storage of liquid fuels and electricity calculated by conversion factors *Table 10*;

The carbon dioxide emission factors used for the calculation of combustion installation emissions are taken out of the National Report on an inventory of greenhouse gases for 2002 and are given in *Table 6*
Based on the projected consumption of energy sources during the project implementation and emission factors by *Table 6* the volume of greenhouse emissions is calculated by sectors and years. Data for greenhouse emissions for the period of 2008-2012 are given in *Table 12.*

	Carbon dioxide emissions with project implementation, $t_{CO2eqv.}$			
	Industrial sector	Public and administrative sector	Residential sector	Total
2008	5353	7151	26707	39211
2009	5362	9862	38566	53790
2010	5373	12642	52885	70900
2011	5383	13677	71743	90803
2012	5393	14981	87487	107861

Table 12: Carbon dioxide emissions upon project implementation by sectors, $tco_{2eqv.}$

The use of modern construction technologies, the lack of depreciated gas distribution networks and internal installations, the losses during transportation of natural gas via the gas distribution network and its consumption by end-users are insignificant. Data provided by Overgas Inc. AD regarding the operation of gas distribution networks shows that the released emissions from the annual losses resulting from blowing the pipes before switching them on and other activities are below 0.1%.

Summary

- *The quantity of energy sources substituted for natural gas depends on the gasification rate by sectors in compliance with project stages planned;*
- *The estimation of expected natural gas consumption is made after considering energy efficiency of combustion installations and LHV of substituted energy sources;*
- *During the project implementation the emissions are reduced as a result of substitution of carbon rich energy sources for natural gas and reduced consumption of energy sources due to increased energy efficiency of combustion installations.*

8. ESTIMATION OF EMISSION REDUCTION

8.1. Emission reduction

The greenhouse gas emission reduction was calculated by deduction from the total amount emissions, as per the baseline, of the total amount emissions resulting from the implementation of the project.

The results are presented in *Table 13.*

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Baseline GHG emissions	670314	665201	660469	654900	649717	644306	638018	632125	625328	618933
GHG emissions with project implementation	670314	665201	654315	638637	623089	605095	584227	561224	534525	511072
ERUs	0	0	6154	16263	26628	39211	53790	70900	90803	107861

Table 13: Reduction of GHG emissions with project implementation, tco_{2eqv}

A reduction of **362 566** emissions units will be achieved with project implementation during the period 2008-2012.

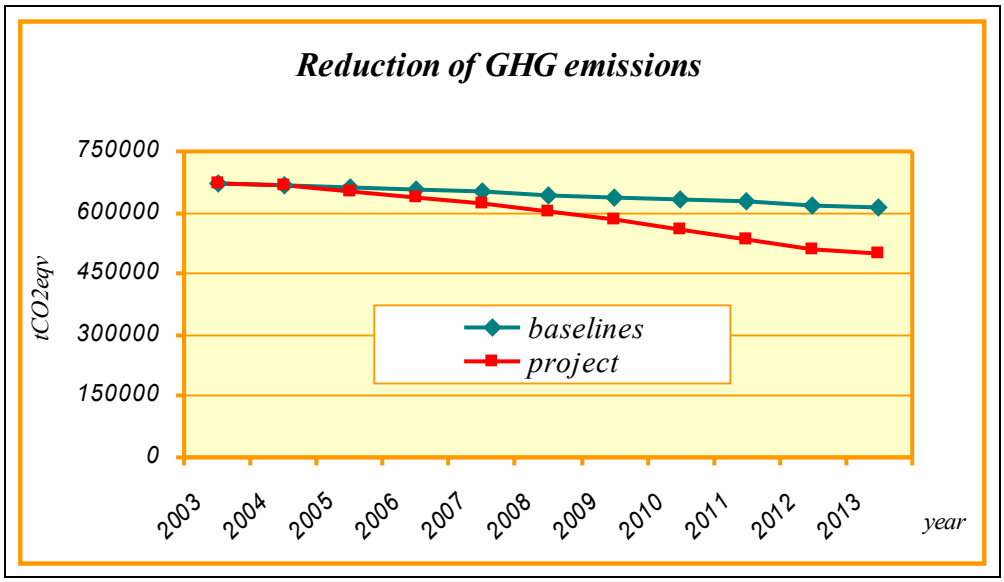

Figure 5: Reduction of GHG emissions, tco_{2eqv}

The implementation of this project will reduce the carbon dioxide emissions by 49 046 units until 2007.

The total amount of the ERUs to be delivered in the period 2008 – 2012 is 300 000 ERUs. (83 % of the total ERUs, forecast for the period).

8.2. Fuel switch emission reduction factors

In PDD the annual consumption of natural gas (item 7) and the resulting reduction in the carbon dioxide emissions for each sector are estimated. By dividing the emission reduction by the natural gas consumption, a factor is obtained quantifying the efficiency emission reduction of the fuel switch from carbon rich fossil fuels to natural gas in a real environment. This factor is designated by "Fuel switch emission reduction factor" (FSERF) and will be an essential tool in the monitoring procedure. A useful dimension of the FSERF is tco_{2eqv}/ *1000* sm^3.
The FSERF depends on the structure of the used energy sources and on the status of the combustion installations before gasification. *Table 14* shows the FSERF by end-users' sectors and by years. *Table 15* shows FSERF by years for the whole project.

	Natural gas consumption, thousand sm^3	*Emission reduction,* tco_{2eqv} */ERU/*	*Fuel switch emission reduction factor,* tco_{2eqv}*/thousand* sm^3
Industrial sector			
2008	5799	5353	0.92
2009	5863	5362	0.91
2010	5928	5374	0.91
2011	5993	5383	0.90
2012	6059	5393	0.89
Public and Administrative sector			
2008	6571	7151	1.09
2009	9115	9862	1.08
2010	12105	12642	1.04
2011	13315	13677	1.03
2012	14176	14981	1.06
Household sector			
2008	8880	26707	3.01
2009	13126	38566	2.94
2010	17910	52885	2.95
2011	23043	71744	3.11
2012	27589	87487	3.17

Table 14: Fuel switch emission reduction factors by sectors and by years

All sectors	*Natural gas consumption, Thousand* sm^3	*Emission reduction,* tco_{2eqv} */ERU/*	*Fuel switch emission reduction factor,* tco_{2eqv}*/thousand* sm^3
2005	3457	6154	1.78
2006	9484	16263	1.71
2007	15386	26628	1.73
2008	21250	39211	1.85
2009	28104	53790	1.91
2010	35943	70900	1.97
2011	42350	90803	2.14
2012	47824	107861	2.26

Table 15: Fuel switch emission reduction factors by years for the project

9. MONITORING PLAN

9.1. Main principles

- To control and determine the greenhouse gas emissions with project implementation as an indicator will be used the total annual natural gas consumption from the end-users by sectors;
- For each sector the fuel switch emission reduction factor for converting of monitored natural gas sales in emission reduction units as defined in item 8 of the PDD is used;
- The fuel switch emission reduction factor include the fuel switch effect and reduced energy consumption due to the increase of the efficiency of the combustion installations;
- The calculation of the total amount of realized ERUs include natural gas sales in the three sectors, and the realized emissions reduction from the project is defined;
- The contractual emission reduction units are determined based on the realized emissions' reduction;
- At a constant calorific value, changes in natural gas composition have no effect on the carbon dioxide emission factor. On energy base the carbon dioxide emission factor is identical for all natural gases of distribution quality[15].
- In case of a change in the calorific value of the supplied natural gas compared to that taken into account in the PDD, a recalculation of natural gas quantity will be done.
- The reported natural gas sales under this project in the industrial and public and administrative sectors include only the users that have signed declarations for adding their ERUs to the total amount of ERUs under the project with a supplier Overgas Inc. AD

This approach is justified due to the following facts:

- Only natural gas is replacing all currently used fuels;
- In absence of this project end-users would use non-natural gas fuels.

[15] ***(www.eia.doe.gov/cnaf/electricity/epav2/html_tables/epav2ta3p2.html)***

9.2. Monitoring plan for the reporting of the realized greenhouse gas emissions reduction

Year	Natural gas consumption, Thousand sm^3	Fuel switch emission reduction factor, tco2/thousand sm^3	Carbon dioxide emission reduction /ERUs/, $tco_{2eqv.}$
Industrial sector			
2008		0.92	
2009		0.91	
2010		0.91	
2011		0.90	
2012		0.89	
Public and administrative sector			
2008		1.09	
2009		1.08	
2010		1.04	
2011		1.03	
2012		1.06	
Household sector			
2008		3.01	
2009		2.94	
2010		2.95	
2011		3.11	
2012		3.17	

Table 16: Calculation of the realized greenhouse gas emissions' reduction

In the public and administrative sector natural gas will replace heavy fuel oil and gas oil. The carbon dioxide emission factors of heavy fuel oil and gas oil have similar values; therefore the changes in fuel switch emission reduction factor for these two sectors are not so harsh. The use of wide range of fuels with different emission factors by the households does not allow giving a synonymous expression of the impact of each fuel on FSERF. The difference in the efficiency factor of various combustion installations also impacts on FSERF, but to lesser extent.

9.3. The activities responsibility, providing for monitoring

- Varnagas 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 33.4 MJ/m^3

9.4. Monitoring implementation technology

The monitoring of the greenhouses gas emissions during the project implementation includes supervising and determining the emissions, released by the natural gas burning in the

combustion installations of the end-users and the methane losses in gas distribution network at the delivery to the end-users. Indicators for the quantity of GHG emissions are the amount of purchased gas received in gas distribution network, the amount of losses at delivery and the amount of sold natural gas. For determination of these quantities reported data are used as follows:

- The consumption of natural gas as per the readings of Bulgargas AD gas meter;
- The summarized consumption read by the gas meters of the end-users;
- The amount of losses, estimated as difference between the delivered and sold quantities and those read by the remote monitoring and control system OVERCOMM 2.0.

In *Appendix 7* company procedures of Overgas Inc. AD for quality assurance of operation and reporting on natural gas consumption and leakage are presented.

9.5. Methods for quality control and procedures for quality ensure

The quality of delivered natural gas, consumers' 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 *Appendix 8* a 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 *Appendix 9.*

9.6. Statistical methods used in determining the consumed natural gas quantities

To carry out the monitoring implementation as described in it.9.1, 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 *Appendix 10*.

Summary

The monitoring plan is based on observation of the basis factor – quantity of natural gas consumption.
The volumes of consumed natural gas by sectors are initial data for estimation of the realized reduction of greenhouse gas emissions.
The monitoring results will serve as a basis for reporting on submitted ERUs, as well as for the validation by independent body of the quantities realized ERUs.
The method and the sequence of monitoring are clear and are a guarantee for obtaining trustworthy and reliable results.

10. STAKEHOLDER COMMENTS

The requirements for the construction of gas transfer and distribution networks in and outside urbanized territories are treated and controlled in a number of legislative acts, rules and regulations, and other normative documents. By virtue of these documents, the stakeholders – the town communities, municipal administration, specialized state control bodies and communication companies – are deeply involved in each stage of the required procedures.

For the gasification on the territory of Varna municipality, which is included in the scope of license issued to Varnagas AD, the public has been informed through an announcement published in the State Gazette about the following:

- Development of a gasification scheme;
- Approval of the gasification scheme by a Decision of Municipal Council

There have not been any objections or negative opinions on the contents of the gasification scheme.

The Procedure carried out in compliance with the Environmental Protection Act gives the most concerned parties the opportunity to express their opinion on the project implementation. It includes the following stages:

- An Environmental Impact Statement (EIS) is prepared by independent licensed experts;
- The public is informed about this EIS through the local press and a date is announced on which there will be a discussion of the project;
- Public discussion is carried out – the public in the concerned settlement is introduced to the project and the stakeholders express their opinions in a discussion afterwards;
- If there are no objections whatsoever, the Expert Council of the competent body – Regional Inspectorate of Environment and Waters (RIEW) approves the Environmental Impact Statement and issues a Decision on the implementation of the project.
- Validity of the REIW Decision has been duly extended over the years in compliance with the requirement of the Environmental Protection Act (EPA).

In connection with an amendment to the applicable environmental protection legislation and introduction of a regime of discretion by the competent body as to the need of EIA on the basis of the investment proposal:

- The local press informs the public about the investment intent;
- A request addressed to the competent body is prepared with scope sufficient to serve as grounds for deciding whether an EIA is necessary;
- In case there are no objections and after consideration of the justification given in the investment proposal the RIEW issues a Decision on the Need of EIA.

The environmental policy of OVERGAS includes the practice of inviting not only the stakeholder institutions as required by the Environmental Protection Act but also representatives of NGOs, scientific institutes and managers of the big enterprises that are provided for gasification by the project, when holding the public discussions. The purpose is to make the investment projects more transparent to the public, to introduce the advantages of using natural gas instead of solid or liquid fuels and to consider the opinions of the stakeholders.

The public discussion of the Environmental Impact Statement was held as follows:

It was attended by experts from Varna municipality, competent body RIEW, ecological parties, Ministry of Regional Development and Public Works, Universities Professors, experts

from "Overgas Inc." AD, independent experts, journalists and citizens. The representatives of OVERGAS Inc. AD presented the project, and the independent experts presented the Environmental Impact Statement. The questions asked by the stakeholders concerned mainly specifics about the speed of the project implementation and the measures of safe use of natural gas. A presentation was made of a marketing strategy for preparation of advertising materials, video clips providing the citizens with information about the gasification process and the use of natural gas, the technical and technological control ensuring safe and trouble-free use of natural gas. The stakeholders' statements illustrated a positive attitude towards the gasification project and expressed a desire for its faster implementation. There were no negative written or oral statements concerning the project.

Following the public discussion and the sitting of the Expert Environmental Council, the Director of RIEW – Varna issued a Decision on the Environmental Impact Assessment for the site Gasification of Varna by which he granted permission for its implementation.
In connection with an amendment to the applicable environmental protection legislation and introduction of a regime of discretion, the REIW herewith issues a Decision upon discretion that no environmental impact assessment is required for the investment proposal for Gasification of Varna *(Appendix 11**).***

The following stages of the procedures, during which the public and stakeholders have been informed about the project, should be pointed out:

- the pre-feasibility studies for Varna have been considered and approved by a committee of Varna municipality;
- Complete information about the technical infrastructure built on the territory of Varna has been submitted by: the Electric Power Distribution Company, the Water and Sewerage Company, the Bulgarian Telecommunications Company, the Linear Cable Unit;
- The scope of the design plans and specifications prepared is for 131 km;
- The design plans and specifications for 90 km have been coordinated pursuant to the requirements of the Territorial Development Act with the following: State Technical Supervision, Regional Fire Service and Roads Executive Agency. The detailed designs have been coordinated without any remarks. The coordinated designs have been approved by the Municipality and the relevant construction permits have been issued for them;
- In accordance with the law requirements the construction permits issued should be posted at a visible place in the Municipality for information to the public and personally announced to the stakeholders. Objections and comments to the construction permits have not been filed.

Summary

No negative opinions or statements were submitted concerning the implementation of the project under all aforementioned procedures giving the opportunity to obtain opinions and comments from the stakeholders – the population of the towns, municipal administration, the specialized state control bodies and the communications companies or experts from science and research organizations. The public was interested in the faster implementation of the project, they were positive towards the gasification projects, were informed of their economical, social and environmental advantages for both the settlement as a whole and each individual consumer.

11. ENVIRONMENTAL IMPACT

The environmental impact of the project is examined thoroughly in the environmental impact statement (EIS). Independent experts prepared the report in compliance with Bulgarian law effective during the respective period of time.

The positive decision No 10-2 (50) 1998 made by the Regional Inspectorate of Environment and Water (RIEW), Varna, is added to the EIS. It endorses the implementation of the project. ***(****Appendices 12)*

The validity of this decision has been prolonged in accordance with the law. ***(****Appendices 12.1, 12.2, 12.3****)***

1. Summary of the EIS of the project for gasification of Varna municipality

The report examines the impact of the gasification project on the environment during construction and operation of the gas distribution network. Special attention is given to the quality of natural gas, the technological processes during project implementation, and their eventual impact on environment elements.

Experts have examined two hypotheses in order to assess the impact: 1) current situation (use of conventional fuels) i.e. without implementing the project, and 2) gasification of sites in the industrial, public and administrative, and household sectors.

The report assesses the impacts of gasification on the population (including its material and cultural heritage) and on the natural resources (including flora, fauna, soils, water, air, climate, landscape, and underground structures) along with their interactions.

The studies of independent experts reflected in the report indicate that the composition of emissions from combustion installations changes along with the increase of the natural gas share as an energy source in Varna municipality. Greenhouse gases are reduced significantly whereas sulfur oxide emissions and particles emissions are eliminated. The studies establish the advantages of natural gas in comparison to solid and liquid fuels and the urgency of the project for improving environment conditions in Varna.

The modern methods to forecast and design emissions, in the context of the current tendencies for development of the city, clearly indicate that the project construction and operation will not have a negative impact on environment components. During construction, individual disruptions of the environment may emerge. They will be short-lived, of local character that will have no cumulative effect. The gasification of sites in the three consumer sectors will improve the state of ambient air and environment and will have a favorable effect on the sustainable development of the municipality.

At the end of 2003 the Law on Environment Protection was amended, which led to certain mitigation in relation to the preparation of the EIS. In compliance with the new requirements, the investor submitted to the control authority – RIEW, Varna, an application to consider the need of an EIS. The resulting Decision No 55-ПР/2003 stated that there was no need to

prepare a new environment impact assessment because the project implementation does not involve negative impacts on environment. No objections against it have been registered.

Summary

The conclusions of the independent experts that prepared the EIS for the project for gasification of Varna indicate categorically that the project has a lasting positive effect on environment components and human health, which is due to substituting solid and liquid fuels for natural gas. The experts define the project significance as ecological and social.
The decision, issued by the control authority – RIEW, Varna is important in order to obtain a construction permit.

ABBREVIATIONS USED IN THE DOCUMENT

CHP	Combined Heat and Power Plant
CO_2	Carbon Dioxide
CO_{2eqv}	Carbon Dioxide Equivalents
EEC	End Energy Consumption
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
ERU	Emission Reduction Unit
ERUPT	Emission Reduction Unit Procurement Tender
EU	European Union
FSERF	Fuel Switch Emission Reduction Factor
GDN	Gas Distribution Network
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GIS	Geographic Information Systems
IMF	International Monetary Fund
IPCC	Intergovernmental Panel on Climate Change
ISO	International Organization for Standardization
JI	Joint Implementation
LHV	Low Heating Value
LPG	Liquid Petroleum Gas
MoEW	Ministry of Environment and Waters
NGOs	Non-governmental Organisations
PDD	Project Design Document
RIEW	Regional Inspectorate of Environment and Waters
sm^3	All sm^3 represents, unless otherwise stated, a standard m^3 at 1.01325 bar and 293.15 K
SME	Small and Medium Enterprises
UN	United Nation
UNFCCC	United Nations Framework Convention on Climate Change