Reduction of greenhouse gases by gasification of the towns of Veliko Tarnovo, Gorna Oryahovitsa and Lyaskovets

JI Project Design Document

July 2003

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1. PROJECT INFORMATION

1.1. Project characteristics

Supplier

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Date of registration:	Company case №30913/1992 Sofia District Court

Project partners:

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Company name:	**Rahovetsgas 96 AD**
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Information about the industrial enterprises and the public and administrative users in Veliko Tarnovo, Gorna Oryahovitsa and Lyaskovets is given in *Annex 1*.

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1.2. Project Abstract

Project Title

REDUCTION OF GREENHOUSE GASES BY GASIFICATION
of the towns of Veliko Tarnovo, Gorna Oryahovitsa and Lyaskovets

Abstract

The project aims at the reduction of greenhouse gases by switching to natural gas from carbon rich and polluting liquid and solid fuels, used by the end users in industries, public and administrative sector, and households in the three towns, and increasing the energy efficiency of their combustion installations. This switch will lead to essential reduction of carbon dioxide emissions.

The project involves construction of a gas main branch, and gas distribution networks, and restructuring of the end users' installations.

The Project implementation will contribute significantly to the sustainable development of the towns of Veliko Tarnovo, Gorna Oryahovitsa and Lyaskovets.

Project location

Host country **Republic of Bulgaria**

The Project covers the territory of three towns /Veliko Tarnovo, Gorna Oryahovitsa, and Lyaskovets/, which are situated in Central North Bulgaria near the national transport gas pipeline from the Northern semi-ring of the republican gas pipeline network. */Figure 1/*

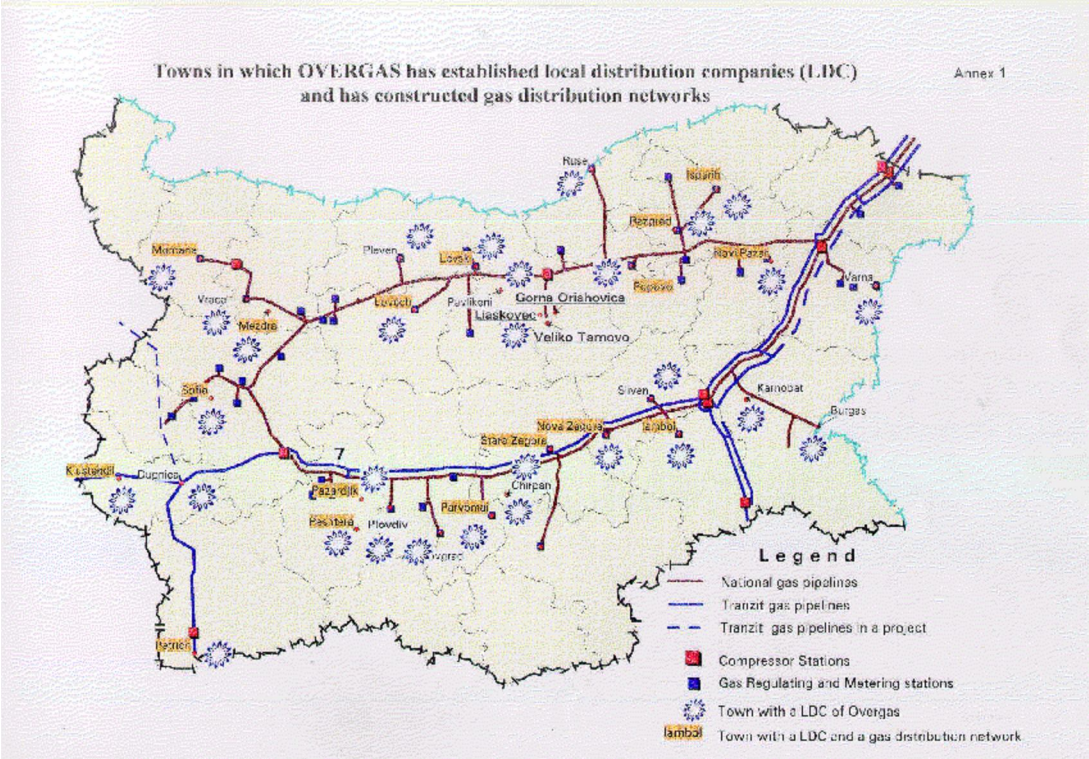

Figure 1: The Bulgarian gas transport network. /LDC: local distribution company/

Start of the feasibility study: 1998

Construction starting date: March 2004

Construction finishing date

At the end of 2008 the major gas distribution networks in the three towns will be completed. All industrial, public and administrative consumers, as well as 43% of the households / in the three towns/ at that time will be in a position to switch to natural gas. The project will continue to develop and by 2012 the number of households using natural gas will increase to 45% of the total amount of households in the three towns.

1.3. Background and justification

1.3.1. Gasification – definition

The gasification involves two steps:

- Bringing natural gas to the end-users by constructing a transport and distribution network and
- Introducing natural gas to the end-users in industrial, public and administrative sectors, and households.

This project will make the natural gas available to the end-users in the region of Veliko Tarnovo, Gorna Oryahovitsa and Lyaskovets. By gasification it is possible to introduce cogeneration on a large-scale. The cogeneration will further enhance the efficient use of primary energy sources.

1.3.2. Legal Framework

The legal regulation of both the gasification and the construction of the gas distribution networks on the territory of the towns is considered in three aspects:

- Licensing regime for distribution of natural gas for a certain period and a certain territory in the towns;
- Permission of a regime for the construction of the gas distribution network in the towns;
- Technical norms and safety rules for operation of gas networks and facilities.

"Rahovetsgas 96" AD holds licenses for the activity "Distribution of Natural Gas", issued by the State Energy Regulatory Commission in compliance with art. 12 § 1 and 2 of the Preliminary and Concluding Provisions of the Energy and Energy Efficiency Act /EEEA/ as follows:

- With Decision No. L-016/30.10.2000, a license was issued for the Municipality of Gorna Oryahovitsa for a period of 20 years;
- With Decision No. L-017/30.10.2000, a license was issued for the Municipality of Veliko Tarnovo for a period of 20 years;
- With Decision No. L-057/08.01.2001, a license was issued for the Municipality of Lyaskovets for a period of 10 years.

1.3.3. Competitive Environment

- ***Economic benefits of natural gas in comparison to the other energy sources used in the three sectors :***

In the industrial sector the price for 1 kWh energy derived from natural gas is about 23% lower than the price of 1 kWh energy from heavy fuel oil, which is the traditional energy source. In the public and administrative sector where the major substituted energy source will be gas oil, the price of natural gas is about 38% lower. In the household sector, the price of natural gas is 50% lower than the price of electricity. /Annex 2/

The low price of natural gas, compared to the currently used energy sources, will encourage consumers to adjust their energy equipment to using natural gas. Additional end-user benefits for the use of natural gas are:

- Ability for individual regulation and measurement of the consumption;
- No need for storage facilities for the energy sources;
- Reduction of costs for pre-heating during transport and storage of heavy fuel oil.

➢ ***Technological benefits***

- The carbon dioxide emission factor for natural gas is lower than that of the fuels to be replaced;
- High energy efficiency of the combustion installation and energy systems working with natural gas;
- Opportunity for introduction of new energy efficient technologies.

➢ ***Environmental benefits***

- Reductions of greenhouse gas /GHG/ emissions, abolition of the emissions of sulphur oxides and dust;

The currently used solid and liquid fuels have high carbon dioxide emission factors /EF/. During the burning process many of them also emit hazardous substances and other greenhouse gases. The substitution of solid and liquid fuels for natural gas leads to a reduction of greenhouse gas emissions, acid oxides, heavy metals and dust, due to the natural gas's lower emission factor. The data on carbon dioxide emission factors for the different fuels are shown in table 1.

Fuel	***Carbon dioxide emission factor t_{CO2} /TJ***
Heavy fuel oil	77.5
Gas oil	74.1
Subbituminous coal	96.1
Bituminous coal	94.6
Briquettes	96.1
Natural gas	56.1

Table 1: Carbon dioxide emission factors. Original data are taken from the IPCC tables in t_C/ TJ and converted to t_{CO2}/TJ.

- Lack of slag disposal facilities, which are compulsory when using solid fuels;
- The leakage resulting from the use of liquid fuels are reduced to a minimum.

➢ ***Social Benefits***

- Improved labour conditions and living standards - low rate of pollution of the working places and residential buildings;
- Growth of regional economy by increased efficiency, increased competitiveness and new jobs creation;
- Improvement of people's health as a result of the air quality improvement.

1.3.4. History and preconditions for the initiation of the project

In the three towns, as of this moment, there is no gas supply infrastructure available.
The state licenses for performing the activity called "distribution of natural gas" on the territory of the three municipalities, held by "Rahovetsgas '96" AD, entitle the company to the exclusive right of being the sole supplier of natural gas to the consumers from the three sectors: "Industrial", "Public and administrative" and "Household", which enables meeting the needs of the end users for more efficient, cheaper and environmentally friendly fuel.

- ***History***

The first surveys for the gasification of the three towns were carried out by "Overgas Inc." AD marketing experts in 1997. The marketing information was collected through direct questionnaire for each industrial enterprise and public and administrative consumer. The housing stock used by households was thoroughly studied.
The last update of the market research from November 2002 reveals the increased interest on behalf of potential consumers of natural gas in the faster implementation of the project, in changing the basic fuel used and increasing energy efficiency. Digital models of the cadastre plans have been prepared, as well as general gasification schemes, preliminary research, environment impact statement, detailed designs and building permits have been obtained.

- ***Preconditions***

- The strategic geographic situation of the three towns;
- Their proximity to the gas mains;
- Favourable conditions for development of the industry and the public and administrative sector;
- Forecasts for high and stable energy consumption;
- The willingness of the users to use more efficient, cheaper and environmentally friendly fuel - natural gas.

1.3.5. Problems the implementation of the project will solve

The implementation of the project has strategically regional importance with the following economical, social and ecological impacts:

- Improvement of the environmental condition of the towns;
- Introduction of contemporary technologies;
- Decrease of the energy consumption of the Gross domestic product /GDP/;
- Overall revival of the regional economy;
- Cheaper product due to the use of cheaper fuel;
- Decrease of unemployment.

As far as the development of household gasification is concerned, it is essential to highlight the fact that a developed district heating system does not exist in the towns of Gorna Oryahovitsa and Lyaskovets. The major source of heating in this sector is solid fuels, and the implementation of the project is of great importance for meeting the needs of the population for heating.

1.3.6. Major economic activities of the partners in the project and description of their relations

"Overgas Inc." AD is the biggest private investor on the gas market in Bulgaria. It was established in 1992 as a joint stock company with 50% participation of the Russian gas company "Gazprom". Now the company has experience, professional potential and financial resource to guarantee to their partners and clients reliable implementation of all projects and to help the development of the market for natural gas in Bulgaria. As of the present moment, they have invested USD 33 million for the implementation of gasification projects in 19 towns.
The company carries out marketing research and technical and economic studies, analyses, evaluates and develops gas investment projects, secures their financing and manages the investment process. "Overgas Inc." AD is a shareholder in 31 companies. Of these, 26, established jointly with municipalities, are local gas distribution companies, in which "Overgas Inc." AD has the majority stake. They invest, design, construct, operate, and repair the gas distribution networks, facilities and equipment for the use and sale of natural gas.

"Gastec BG" AD – the Bulgarian centre for gas technologies was established in 1995 with its major scope of activity being: consulting, research and design of gas distribution networks, gas facilities and gas installations, technical supervision of gas installations, metrological checks of gasmeters and personnel training in the field of gas technologies. Shareholders in the company are GASTEC NV – the Netherlands, "Overgas Holding" AD and "Overgas Inc." AD.
The preparation of detailed designs for gas distribution networks, for gas facilities and gas installations for the consumers in Veliko Tarnovo, Gorna Oryahovitsa and Lyaskovets is carried out by "Gastec BG" AD. The company has developed detailed designs for the gas distribution networks and sites for 24 towns in Bulgaria.

The construction of gas networks is performed by **"Overgas Engineering" AD**, which holds a certificate of approval to the quality management system standard ISO 9001:2000 certificate issued by Lloyd's Register Quality Assurance.
"Overgas Engineering" AD was registered in 1993 with the following scope of activity: production, trade, scientific and research surveys, consultancy, and engineering activities in the field of oil and gas.
The company has worked on sites in 18 towns in the country and has built the gas distribution networks and gas facilities, gas main branches and automatic gas distribution stations. "Overgas Engineering" AD has carried out preliminary research and detailed designs for the gasification of 50 towns in the country, part of the transit gas main for Turkey and a project for a gas distribution network and facilities in the town of Kriva Palanka, Republic of Macedonia.

Partners of "Overgas Inc." AD in the implementation of the projects for the gasification of settlements are the **Municipalities** of the respective towns, which are also shareholders in the established local gas distribution companies. For the implementation of the project for the gasification of Veliko Tarnovo, Gorna Oryahovitsa and Lyaskovets, "**Rahovetsgas '96"AD** was established in 1996. The shareholders in the company are "Overgas Inc." AD, **Gorna Oryahovitsa Municipality, Veliko Tarnovo Municipality, Lyaskovets Municipality** and natural persons.

The end users in the industrial and public and administrative sectors represent 60 % of the total amount ERUs for the project, in the result of fuel switch. For that is of great importance that on this early stage we have confirmation of the Municipal governments and company managers that they will switch to natural gas and generated by them emission reduction units

to be added to the total ERUs for the project. This is confirmed by statements from the Municipal governments and declarations from the managers of the industrial companies.

The General Conditions of the natural gas sale contracts between Rahovetsgas 96 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 the Reduction of the Greenhouse Gases by Gasification Project for the towns of Veliko Tarnovo, Gorna Oryahovitsa, and Lyaskovets.

1.3.7. Related financial commitments

The total investments required under this project amount to EUR 35 673 000, of which EUR 4 600 000 will be invested in the construction of the Gas Main Branch /GMB/ and Automatic Gas Regulation Station, EUR 11 213 000 - in the construction of the gas distribution networks in Veliko Tarnovo, Gorna Oryahovitsa and Lyaskovets /2004-2012/, and EUR 19 860 000 - for the adaptation or replacement of the end users' appliances to use natural gas /2004-2012/.

1.3.8. Additionallity

The ERUPT 3 program will rise additional funding for the gasification project. This funding will increase the feasibility of the project in general. The inclusion of the household consumers on a large scale, requiring expensive adaptation of their installations, will be facilitated to a large extend by the additional funding.

1.4. Intervention

1.4.1. Project goals

- Gasification of the towns of Veliko Tarnovo, Gorna Oryahovitsa and Lyaskovets;
- Replacement of currently used solid and liquid fuels and part of the electric power by natural gas from all industrial and public and administrative end users and most of the users in the household sector of the three towns;
- Reduction of greenhouse gases and procurement of 400 000 tons emission reduction units to Senter Internationaal according to the Joint Implementation mechanism.

1.4.2. Project purpose

Reduction of greenhouse gases by gasification of the towns of Veliko Tarnovo, Gorna Oryahovitsa and Lyaskovets.

1.4.3. Project results

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

- Reduced greenhouse gas emissions: In the first year the reduction will be 6 526 ton carbon dioxide. The reduction will grow to 81 646 ton in 2007 and 106 018 ton in 2012;
- Reduced total emissions of polluting components in the air;
- Enhancing energy efficiency of combustion installations in the region;
- Reduced energy costs for households by lower cost of the used energy source and increased efficiency of the combustion installations;
- Increased living standard qualities: Ensuring a higher level of human health as a result of improved air quality, raising household standards, automation of combustion processes allowing easy and safe operation of gas appliances and opening of new and attractive jobs.

1.4.4. Activities:

- Construction of 50 km gas main branch and two Automatic gas regulation stations /AGRS/;
- Construction of 200 km gas distribution network in Veliko Tarnovo, Gorna Oryahovitsa and Lyaskovets;
- Construction of internal installations for 43 industrial enterprises, 83 sites in the public and administrative sector and over 17 000 households;
- Commissioning and operation of gas distribution networks and end users' installations in the three towns;
- Monitoring of natural gas consumption and realized emission reduction units.

Stages in the implementation of the project

The implementation of the project for the gasification of the towns of Veliko Tarnovo, Gorna Oryahovitsa and Lyaskovets started alongside with the design and construction of the gas main branches and two AGRSs. The project envisages the construction of 200 km gas distribution network of steel and polyethylene gas pipes, 9 690 ancillary facilities in the towns of Veliko Tarnovo, Gorna Oryahovitsa and Lyaskovets and the re-equipment of the end users installations.

Adjustment of the fuel installations for using natural gas has to be made for 43 industrial enterprises, 83 public and administrative buildings and over 17 000 households.
Gas supply is planned to start simultaneously in the three towns, and the starting date varies for the different sectors – for the industrial in 2004, for public and administrative and households in 2005.

As a whole, the construction of the gas distribution network has to go through the following stages:

- ***First Stage /2004/***

1) The construction of 50 km gas main branch for high pressure – 50 bar and two AGRS with P_{outlet} = 12 bar.
2) The project starts in the three towns:
   Veliko Tarnovo
   - Construction of the network of steel pipes at 12 bar, with a total length of 13.5 km.

   Gorna Oryahovitsa
   - Construction of the network of steel pipes at 12 bar, with a total length of 14.3 km.

   Lyaskovets
   - Construction of the network of steel pipes at 12 bar, with a total length of 5.0 km.

Gas supply to the industrial zones of the towns is planned to start during that stage.

- ***Second stage /2005 - 2008/***

During this stage the gas distribution network at 4 bar for the housing areas of the towns will be developed. The rest of the industrial zones, as well as the public and administrative and housing buildings located close to the major network will be connected.

Veliko Tarnovo
- Construction of the major and distribution network of PE-HD /polyethylene high density/ pipes at 4 bar with a total length of 45.4 km;
- Construction of branches for industrial consumers with a length of 0.5 km.

Gorna Oryahovitsa
- Construction of the major and distribution network of PE-HD pipes at 4 bar with a total length of 77 km;
- Construction of branches for industrial and public and administrative consumers with a length of 1.2 km.

Lyaskovets
- Construction of the major and distribution network PE-HD pipes at 4 bar with a total length of 23.1 km;
- Construction of branches for industrial and public and administrative consumers with a length of 2.7 km.

Third stage /2009-2012/

The gasification of the households will continue during this stage. The already existing network will be made denser. In cases of construction changes in the existing residential areas or in cases of eventual construction of new zones, a gas distribution network will be built for them as well.

Market penetration

The market penetration is a two step process. In the first step the natural gas is made available for the end-user /network connected/. In the seconds step the end-users replace the traditional energy sources, as far as appropriate, to natural gas /switched/. Table 2 shows the market penetration as a percentage of the total number of end-users in the related sector, anticipates for gasification as per the end of the 10-year forecast period

Stage / ***Sector***	***At the end of 2005***	***At the end of 2008***	***At the end of 2012***
Industrial	43%	100%	100%
Public and administrative	29%	100%	100%
Household*	35%	94%	100%

Table 2. Market penetration of natural gas by sectors

Note: *The project foresees that at the end of the period 45% of the total amount of households in the three towns to be gasificated.*

Table 2 presents conservative estimate of the market penetration as available from the "Overgas Inc." AD marketing studies. To the experience of "Overgas Inc." AD the real rate of market penetration will be higher.

1.4.5. Actors

The project is implemented by the following actors:

"Overgas Inc." AD
"Gastec BG" AD
"Overgas Engineering" AD
"Rahovetsgas 96" AD
Local municipalities
Industrial end users
Public and administrative end users
Household end users

"Overgas Inc." AD is the leading company in the project. "Gastec BG" AD and "Overgas Engineering" AD provide technical support to "Overgas Inc." AD. "Rahovetsgas 96" AD is the utility distributing and selling natural gas to the end users. The local municipalities actively support the gasification.

2. GHG SOURCES AND SINKS AND PROJECT BOUNDARIES

2.1. Description of the sources of GHG emissions under the project

The project includes the delivery of natural gas and its use from most of the consumers in the industrial, public and administrative and household sectors. In addition to the substitution of solid and liquid fuels for natural gas, the present project provides conditions for reduction of fuel consumption by means of energy efficient technologies in the process of adjustment of the energy systems to operate on natural gas.

The end user combustion installations in the three sectors are the major fuel consumers. The substitution of the currently used solid and liquid fuels with high carbon dioxide emission factor for natural gas leads to the greatest reduction of greenhouse gas emissions. These emissions are produced directly on-site the project region, which encompasses the territory of the three towns.

The combustion installations in the three sectors are of different type and different energy efficiency. In the industrial and public and administrative sectors the boiler units are designed to use liquid fuels – heavy fuel oil and gas oil. The household sector, and partly the public and administrative sector, uses fire-grate boilers with combustion that operate on solid fuels with low efficiency. Their substitution for contemporary boilers leads to significant reduction of fuel consumption and greenhouse gas emissions.

The gasification creates prerequisites for optimising the energy system and converting to cogeneration, which also leads to reduction of general energy consumption and of greenhouse gas emissions as a consequence. It is quite possible that in the region "Toplofikatsiya VT" EAD could convert to cogeneration. Natural gas is the bridge to the introduction of renewable energy sources, such as wind and hydro energy.

The use of liquid fuels and heavy oil fuel in particular requires heating of tanks and pipes during storage and transportation. Gasification reduces the energy consumption for storage and transportation of liquid fuels, which leads to reduction of fuel consumption and greenhouse gas emissions.

Due to the large use of electric power by households for heating, water heating and cooking its substitution for natural gas will significantly reduce direct off site emissions, discharged in the process of electric power production.

There are losses from the storage and transportation of the solid and liquid fuels, and distribution of electric power low voltage. The losses during liquid and solid fuel transportation and storage are minimal and therefore are not included in the emissions calculation.

The envisaged annual GDP growth of 4-5% for the next few years will improve the living standards and the average in-house temperature and rise of the natural gas consumption. The experience of "Overgas Inc." AD in household gasification enables maintaining reduced energy consumption. This is due to the big difference in the energy efficiency of combustion installations before gasification /0.55 %/ and after gasification /up to 0.9 %/ as well as to the ability to regulate the temperature in various indoor premises to end-users needs.

The use of natural gas allows for abatement of heat spillage and improved temperature isolation of the buildings.

2.2. Direct on-site emissions

Direct on-site emissions are as follows:

- Emissions on substitution of fuels for end users;
- Emissions on optimising the burning process and the energy systems;
- Emissions from the losses for storage and distribution of fuels.

The reduction of direct on-site greenhouse gas emissions is achieved as a result of the use of fuels with lower carbon dioxide emission factor and reduced energy consumption. This is due to the optimisation of the burning process and the energy systems as well as of the reduced energy consumption for storage and transportation of the fuels. The emissions of natural gas losses from the Gas Distribution Network are ignored in the calculations due to their minimal amount.

2.3. Direct off-site emissions

Direct off-site emissions are as follows:

- Emissions on the production of the substituted electric power, including the losses during the transportation of medium and low voltage electric power;
- Emissions on the production of the substituted electric power by on-site cogeneration sources.

The substitution of the electric power used for heating, water heating and cooking leads to reduction of electric power consumption and of emissions in the process of coal mining and electricity generation. The carbon dioxide emission factor for JI projects reducing electricity consumption /in gCO2/kWh/, presented in Senter's Operating guidelines for project design document of JI Projects, Vol.2a, Annex B1, has been used for the calculations.

2.4. Indirect on-site and off-site emissions

The indirect on-site and off-site emissions are below 1 %. They are not included in the emissions calculations in both cases - implementation of the project and absence of project activities.

2.5. Project boundaries

The project boundaries include combustion installations of the industrial, public and administrative, and household end users in the towns of Veliko Tarnovo, Gorna Oriahovitsa and Liaskovets. During the project implementation a large quantity of electricity should be substituted. The project boundaries include also production, transport and distribution of this electric power. Its emission factors are defined by Senter and include optimisation of the energy production facilities during the period up to 2012. Through the negligible losses on the transportation and delivery of solid and liquid fuels, the intermediate storehouses for storage and sale are not included in project boundaries. The constructed gas distribution network is also not included in project limits in view of the fact that is with high quality and reliability /the anticipated losses are less than 0,1%/.

The block-scheme of the project with its main parts and connections and the project boundaries are shown at *Fig.2*

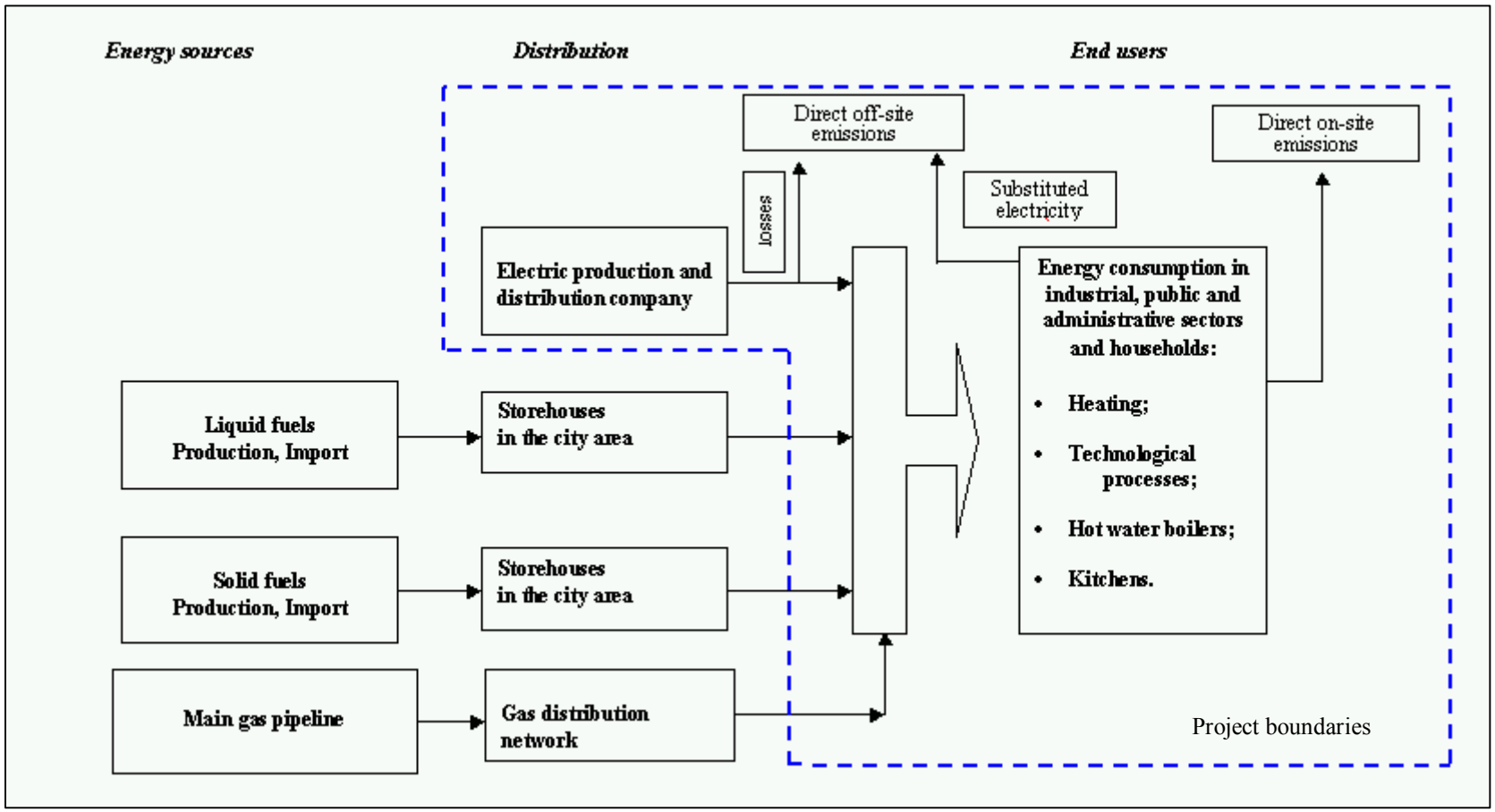

Figure 2: Block-scheme of the fuels delivery after gasification and project boundareis

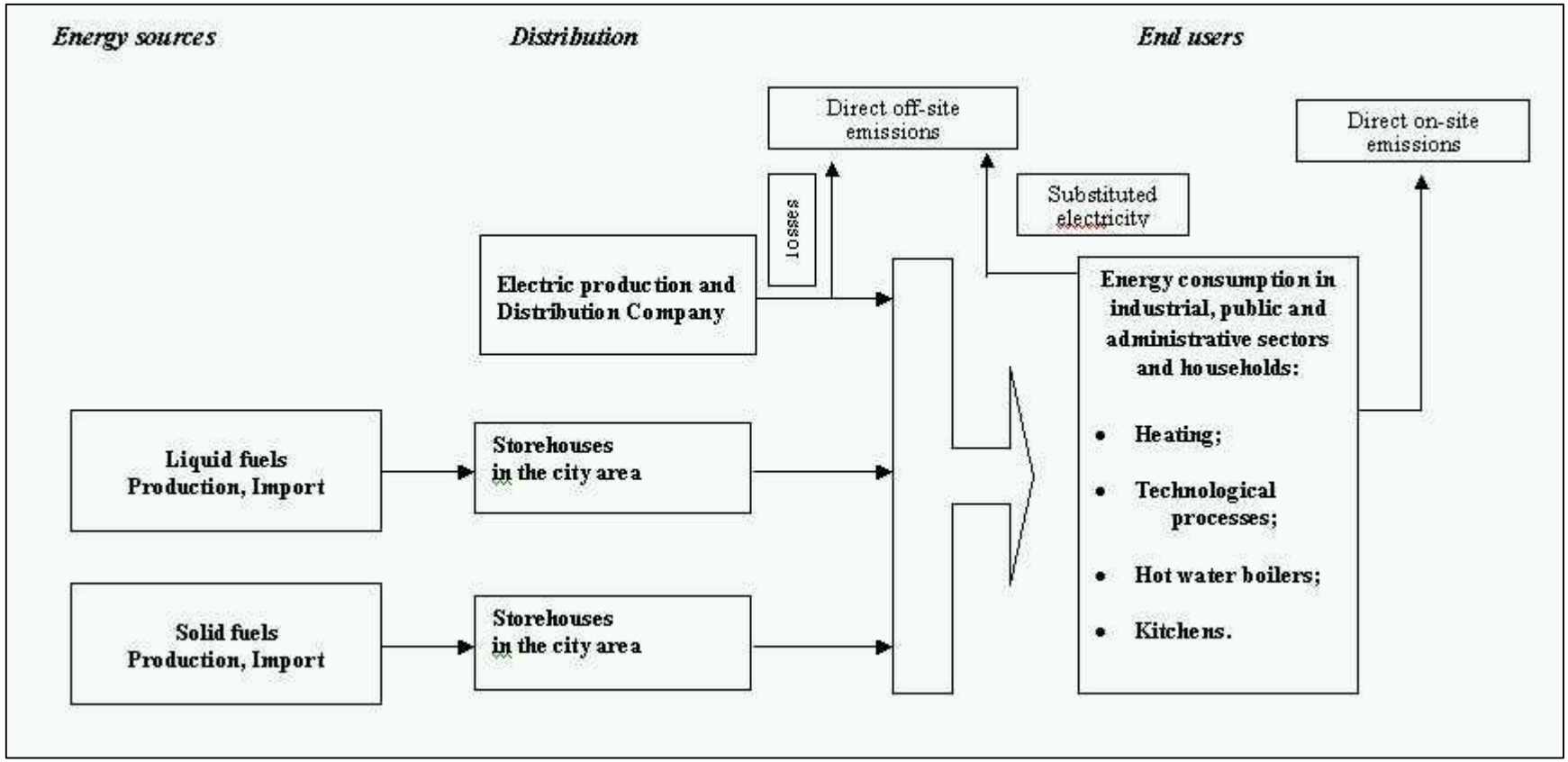

Figure 3: Block-scheme of the fuels delivery before gasification

3. DESCRIPTION OF THE CURRENT DELIVERY SYSTEM

The block-scheme of the current delivery system with its main components and connections is shown on *Fig. 3*.

Information about the status, adequacy and the operation modes of the current delivery system for different energy sources:

⇒ ***Electricity***
Electricity is used for heating, hot water boilers /HWB/ and technological purposes in the industrial sector, the public and administration sector and home HWB facilities. It is the predominant element in the energy balance of the three towns. The energy supply companies are required to provide uninterrupted supply throughout the year. The principal supplier for the country and the region is the National Electric Company EAD /NEC EAD/.

NEC EAD was established as a single proprietor joint-stock company with 100% participation of the state and headquarters in Sofia.

Conveyance of electricity
The high voltage conveyance network owned by NEC EAD consists of:
Pole-suspended power lines:
- 750 kV, total length 85 km;
- 400 kV, total length 2207 km;
- 220 kV, total length 2650 km;
- 110 kV, total length 9167 km;

Transformer substations:
- One step-down substation 750/400 kV with transforming capacity 2 500 MVA;
- 27 step-down substations 400/220/110 kV; 400/110 kV, 220/110 kV with overall transforming capacity 14 404 MVA;
- 209 step-down substations 110/20/10/6 kV with overall transforming capacity 11 249 MVA.

"Electric Power Distribution – Gorna Oryahovitsa" /"Electrorazpredelenie – Gorna Oryahovitsa"/ is a single proprietor joint-stock company. The company provides supply and sale of electricity to consumers connected to the distribution network; maintenance of sites and facilities in compliance to technical regulations; development of the distribution network in view of economic expectations and prognoses for changes in electricity consumption in the region; maintenance and development of auxiliary networks; uninterrupted and high quality electric supply; other consumer services.

"Electric Power Distribution – Gorna Oryahovitsa**"** EAD supplies and sells electricity to 570 889 clients of whom 513 842 are households. The company provides electricity to 57 047 industrial consumers. The household and the industrial consumers are concentrated mainly in the big towns on the territory of **"**Electric Power Distribution – Gorna Oryahovitsa**"** – Gorna Oryahovitsa, Veliko Tarnovo, Gabrovo, Russe, Razgrad and Silistra. The distribution of clients in the rest of the region is relatively even.

⇒ ***Liquid Fuels***
The supply and distribution of liquid fuels /heavy fuel oil, gas oil, diesel oil, and light fuel for ships/ are done by private enterprises of regional and national level. The main supplier is the oil refinery in Burgas, owned by Lukoil. The nearest oil storage supply base of NAFTEX PETROL AD is located in the vicinity of Pleven. A small portion of fuels is delivered by direct import. Liquid fuels are used for industrial purposes /the largest portion/, heating and, in a small degree, for HWB. On the territory of the three towns "Petrol" delivers fuels to subdivisions of the Ministry of Health, the Ministry of Defence, the Ministry of Science and Education, as well as with the Council of Ministers and the Supreme Judiciary Council. Other large suppliers are SHELL, Toplivo and OMV.

⇒ ***Solid Fuels***
Supply and distribution of solid fuels /wood, coal and briquettes/ are done by a number of private companies with existing storage facilities in all three towns.

The consumption of wood and waste wood in the industrial sector in the region of the three towns Veliko Tarnovo, Gorna Oryahovitsa and Lyaskovets is mainly practiced by "Darvoobrabotvane" AD, Veliko Tarnovo. After processing the wood pulp for production purposes, a large part of the waste material is used for the production of heat for industrial use.

The consumption of wood in the public and administration sector is predominantly practiced in the schools of the three towns, which do not have heating installations.

The share of wood in the total energy consumption in the region is equal to 3.2% and the households being their principal user. It is expected that after the gasification the use of wood for heating in the household sector will be gradually reduced.

"Toplivo" AD is the main supplier and satisfies to a great extend the demand for wood and wood pallets in the three towns.

The largest distributor of import coal /from Donbas/ in the region and the country is the shareholder of "Zaharni Zavodi" AD. Solid fuels are used predominantly from Thermal Power Station "Zaharni Zavodi".

Bulgarian coal and briquettes are produced and supplied from the following bigger coal-mining fields:

- Coal mines "Maritsa-iztok" EAD, Radnevo
- Coal mines "Staniantsi" EAD, Staniantsi village, Godech municipality, Sofia region
- Coal mines "Chukurovo" EAD
- Coal mines "Vitren" EAD – Kyustendil
- Coal mines "Pirin" Simitli, Blagoevgrad region
- Coal mines "Antra" EAD
- Coal mines "Cherno more" EAD
- Coal mines "Zdravets" EAD, Dimitrovgrad
- Coal mines "Lev" EOOD

⇒ ***District heating***
Heating energy is produced and delivered to end-users in Veliko Tarnovo by "Toploficatsia Veliko Tarnovo" EAD. The facilities work mainly in the autumn-winter heating period and supply central heating and hot water to households. The fuel used is heavy fuel oil /the biggest consumption of liquid fuels/. It is likely that in the next several years, after completion

of the gasification of Veliko Tarnovo co-generating facilities would be installed for production of electricity, using natural gas. There is no district heating system on the territories of Gorna Oriahovitsa and Lyaskovets, and construction of such systems is not planned.

Summary

The current energy sources used in the project region are nearly only electricity and carbon rich fossil fuels. During the considered projects period, ranging up to 2012, the carbon intensity of the power production is expected to decrease due to the use of nuclear energy, hydro power, lower carbon intensive feedstock and improved conversion efficiency.
The use of wood, providing 3 % of the energy and of propane - 0.4% of the energy in the project region. There is no evidence that the use of wood or propane will increase considerably during the project period. The production of renewable energy on any scale of importance is not envisaged during the project period. The envisaged use of nuclear energy and hydropower in the electricity production is already included in the Senter Internationaal data. After the project period natural gas can act as the commodity providing the bridge to the large use of renewable energy sources.

4. KEY FACTORS INFLUENCING THE BASELINE AND THE PROJECT

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

4.1. External key-factors

4.1.1. Legal Factors

The legal and institutional framework of energy production in the Republic of Bulgaria is laid down in the Energy and Energy Efficiency Act /EEEA/[1]. This act regulates the public relationships related to the management, regulation and effective usage of energy and energy sources as well as the rights and liabilities of legal and natural persons in performing production, import, export, transmission, distribution and trading of electricity, heat and natural gas, increase of energy efficiency and encouragement of renewable energy sources use.

In order to increase **the competitiveness of the internal energy market**, in November 2001 amendments were made to the Energy and Energy Efficiency Act, which laid the foundations for bringing legislation in compliance with the EU acquis communautaire.
A new draft Energy Law is prepared, providing for compliance with the requirements of Directive 98/30/EU. On 8th of May 2003 the Council of Ministers of the Republic of Bulgaria passed the draft Energy Law. The adoption of the Law aims at opening of the market, setting third party access and determination of differentiated prices.

The frequent changes in the acts and secondary legislation in the energy sector can be explained by the will of the executive authorities to establish a market-oriented, effective, sustainable and competitive energy sector, in harmony with EU legislation and allowing for its full integration in the national market. This process of legislative adjustments has been almost completed, when at the end of 2002 the Bulgarian Government concluded the negotiations with the EU on the negotiable items of Chapter Energy2.

National Energy Strategy of Bulgaria

In July 2002 the Parliament adopted the new National Energy Strategy[3]. This was the basis for the introduction of market mechanisms and for restructuring the sector, including improving energy efficiency. Although the new energy strategy focuses on energy efficiency, it includes some environmental aspects, too.
Priority goals set by the National Energy Strategy are the restructuring of the state owned gas transmission company "Bulgargas" EAD, the development of gas supply at low pressure and the introduction of a liberal trade model allowing free choice of a supplier.

[1] Energy and Energy Efficiency Act, *Promulgated in SG issue 64 of 16 July 1999, (amendments, issue 1 of 2000 further amendments issue 63 of 2002.)*
[2] Chapter Energy was temporarily closed on 18.11.2002.
[3] Adopted by the Council of Ministers on 11.05.2002 and approved by the National Assembly by a Decision No. 39, SG, issue 71, 23.07.2002. (www.doe.bg)

Commitments to International Financial Institutions

The Proposal of the World Bank to the Bulgarian Government for granting a programme loan to the amount of USD 450 million for restructuring during the next three years contains the following three major requirements concerning the gas sector:

- Adopting a Programme for developing the market for gas under low pressure by means of an appropriate methodology for the tariffs and vision for opening the gas market;
- Adopting goals and terms for opening the gas market;
- Satisfactory accomplishment of the set goals for liberalisation of the gas market.

The Memorandum of the Bulgarian Government on the co-operation with the International Monetary Fund contains a number of requirements and plans concerning the restructuring and development of the energy sector and in particular the gas sector. They have been included in the Energy Strategy of the Republic of Bulgaria.

Concerning the **environment protection,** in September 2002, the Environment Protection Act was passed. It establishes the legal framework for further progress in the environment impact assessment, the access to information and industrial pollution protection and control /IPPC/.

In terms of the **quality of air,** further progress was made in legislation when in November 2001 the second amendment was made to the Clean Air Act, which introduces the national system of control of the quality of fuels.

4.1.2. Macro-Economic Factors

The energy consumption is basic macro-economic factor, which influenced on the baseline and the project. Energy consumption in Bulgaria, measured as ton oil equivalent per USD 1 000/GDP amounts to 1.57. For comparison, this value is 2-3 times higher than that in West European counties. It is largely due to the significant fall in production in all economic sectors and the long period of time during which the price of energy sources did not correspond to the actual costs. It is needed an active policy focused on increasing energy efficiency through an adequate price policy, developing specific energy services, energy control and effective changes in the structure of energy consumption by region.

The key macro-economic factors' trends in the forecasts and development scenarios for gasification in the studied region for the period 2003 – 2015 are:

- Stable pace of economic development, including:
    - The Currency Board functions until EU accession;
    - Cautious and flexible fiscal policy is implemented;
    - The country's dependence on the IMF is reduced;
    - The structural reform is sped up;
    - Competitive market economy is established.
- Increase in the income of the population and improvement of the conditions for consumer credits;
- Natural gas is placed in a competitive environment among other energy sources by terminating direct and cross subsidising of these energy sources.
- Decommissioning units 3 and 4 of the Kozluduy N-plant at the end of 2006;
- Reduction of energy consumption in the economy and electricity consumption in the household sector.

Expected macro-economic indicators for the country till 2007 /National Plan for Economic Development of Bulgaria till 2007, State Agency for Economic Analyses and Forecasts, April, 2002/[4] are:

- GDP /actual growth/ 5.5%
- Level of inflation 3.5%
- Level of unemployment 10.0%
- Level of savings/GDP 18.6%

The GDP growth has a direct impact on the total amount of energy consumption for the country, including natural gas.

The immediate economic effect for the consumers who have switched to natural gas is formed on the one hand from the difference between the price of the substituted energy sources and the price of natural gas, and on the other, from the higher efficiency of the facilities using natural gas as compared to those using other energy sources.

For Bulgaria, the most significant economic effect from the development of a gas network for low pressure will be the replacement of electricity as a major source of energy, with low-temperature processes for household purposes.

The survey "Energy and Environment" of the World Bank shows that the Bulgarian household differs from all households in south-eastern Europe by the predominant use of electricity, including for heating. The Energy Strategy of Bulgaria points out this fact by drawing attention to the fact that not more than one-fourth of primary energy reaches the consumer through electric energy.

Substituting electric energy for natural gas, the efficiency of which is over 90%, is the most crucial measure for increasing the efficiency of energy consumption and responds to the need for reducing the negative impact of the energy sector on the environment.

4.1.3. Price Factors

Here we should consider and analyse:

- The long-term tendencies in prices and methods for calculating fuel prices;
- The trends in behaviour of the local currency according to the one connected with import of fuels;

The tendencies in the prices of the major energy sources for end consumption are a significant factor for the development of gas supply as it is the ratio between the prices of natural gas and the other energy sources that determines the market demand for gas.

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

– ***Liberalised market for liquid fuels***

The market of liquid fuels in the country was liberalised in 1997. Prices in the country follow the trends in international prices of oil products and are forecast according to their changes and after considering the taxes and fees in the country.

– ***Regulated market of natural gas***

By Decree No. 53 / 6.03.2002 of the Council of Ministers a Regulation was adopted on the formation and application of prices and tariffs of natural gas. As of 1.04.2002, the gas

[4] As of this moment long-term forecasts of macroeconomic indicators is done at state level.

transportation and gas distribution companies have been applying the prices of natural gas formed in compliance with the Regulation.

Prices of natural gas at the point of selling by the gas distribution companies include the following components:

- The price of natural gas at the point of input into the gas distribution network;
- The price for transmission of natural gas along the gas transmission network;
- The price of transmission of natural gas along the respective gas distribution network for the respective consumer group.

The price of natural gas at the input of the gas transmission network is tied to international prices of oil and liquid oil products and is forecast according to the changes therein.

The price of natural gas at the output of the gas distribution network is tied to the investments the local distribution companies had made.

– ***Forecast prices of oil***

The forecast for the price of BRENT type oil, on which the forecast for international prices of oil products is based, has been developed at a price fixation of oil at the level of 2002 and at decreasing price of oil.

– ***Regulated market of electric power***

The forecast price of electric power for household consumption corresponds to the Indicative Schedule for increasing the prices of electric power for the population in accordance with the Energy Strategy of Bulgaria /2002/.

4.1.4. Market Factors

The main market factor is the consumers' potential on the natural gas market on the territory of the towns of Veliko Tarnovo, Gorna Oryahovitsa and Lyaskovets, which is influenced by:

- Consumer need and market demand for natural gas on the territory of the project;
- Availability and supply of energy sources as an alternative to natural gas;
- Availability and supply of natural gas in Bulgaria;
- Approximate forecast amount of natural gas sales, estimated in two aspects – replacement of conventional energy sources: heavy fuel oil, gas oil, electricity, solid fuel by natural gas, and taking up the free niche on the regional market of energy sources;
- The price levels of natural gas in comparison with the other energy sources /*discussed in Price Factors/*;
- The purchasing capacity of the population – in two aspects /*discussed in Social and Demographic Factors/*
  - Flexibility of the consumption of natural gas when increasing the delivery price above a certain level;
  - Whether consumers can afford purchasing and installing the gas equipment;
- Objective evaluation of the company's own potential and that of the competition.

The potential users of natural gas have a positive attitude to use it. Gas supply is economical and satisfies the complex needs of consumers both because of its cheap transport and storage, and maximum flexibility of consumption.

Bulgaria has agreements for import of Russian natural gas and the agreed amounts considerably exceed the actual needs of consumption in the country.

4.1.5. Political Factors

In the early 1990s, the country's transition to democracy and market-oriented economy was characterised by a slow pace of structural reforms and uncertain stabilisation policy. After the economic and political collapse in 1997, the macroeconomic policy and extensive programme for structural reforms resulted in a fast positive change in Bulgaria's economy. Although the duration of the project extends beyond the mandate of the present government, is expected that the policy towards EU accession will be kept.

4.1.6. Social and Demographic Factors

This group of factors is extremely important since they are directly related to the pace of implementation of the project for gasification of the towns of Veliko Tarnovo, Gorna Oryahovitsa and Lyaskovets in the household sector. The impact of these factors depends directly on:

- Increasing the competitiveness of the regional economy;
- Improving the basic infrastructure and environmental protection;
- Developing human resources – improving the standard of living of the households on the territory of the investment project, improving the structure and composition of the population, reducing the level of unemployment, increasing the average income and the purchasing capacity;
- Balanced and sustainable economic development in the region – creating conditions for developing and encouraging SME, creating conditions for attracting foreign investment, reducing the differences among the regions and social groups at the same time improving the overall standard of living.

At the end of 2001, the population of Veliko Tarnovo, Gorna Oryahovitsa and Lyaskovets was 111 545 people[5], which makes up 1.4% of the population of the country or 38% of the population of Veliko Tarnovo District. /Annex 3/

The average unemployment rate in the municipalities of Veliko Tarnovo, Gorna Oryahovitsa and Lyaskovets in 2002 is 0.4% higher than the average for the country. It is expected that during the project duration the private sector will create new jobs and will attract free work force from the state companies that have been closed down or restructured.

The level of unemployment will gradually and smoothly go down and will be near the average forecast values of 10% for the country until 2010. The average gross annual income per capita for 2002 is EURO 1 258, or about 54% higher than the average for the country.[6] The increase of the purchasing capacity of the population until 2010 is expected to grow between 2.7% and 4% per annum.

Veliko Tarnovo District is among the leading districts in terms of attracted direct foreign investments /DFI/ and IHD /Index of Human Development/, regardless of the fact that the district has average indicators in terms of GDP and expenses for acquiring LTA /long-term tangible assets/ per capita.

5 *NSI- Population as of 31.12.2001 (www.nsi.bg.)*

The analysis of the social and economic development of the region in terms of the indicators laid down in the National Plan for Regional Development reveals the following deviations of the values for the district as compared with those for the country /assuming the average values for the country to be 100%/:

Indicators	**Deviation**
- GDP per capita	95 %
- income from economic activity per capita	65 %
- cash income per capita	96 %
- level of unemployment	107 %
- Normal index of human development	104 %
- Relative share of those involved in the private sector	106 %
- foreign investment per capita in USD	63.6 USD

4.1.7. Environmental factors

- ***Release of emissions of greenhouse gases below the quantities fixed by the commitments that Bulgaria assumed under international agreements;***

In compliance with the Basic Scenario of the National Plan for Climate Change and the World Bank's Report 'Energy – Environment', Bulgaria has to meet the requirements of the UN Framework Convention on Climate Change /UNFCCC/ and the Kyoto Protocol for Limiting Emissions of greenhouse gases to 92261 thousand tons per year for the period 2008-2012.

- ***Carrying out the commitments under international agreements for limiting emissions of sulphur and nitrogen oxides***

The gasification offers a possibility and is an alternative solution for Bulgaria in carrying out the commitments undertaken in relation to the EU and the UN for the protection of air, concerning:

- Reduction of greenhouse gas emissions;
- Limiting transboundary air pollution;
- Reducing the damage to the ozone layer.

- ***Developing and synchronising environmental legislation in Bulgaria with the EU acquis***

The major efforts to reach the required reduction of emissions of sulphur and nitrogen oxides and greenhouse gases in Bulgaria are mainly in power production as the major emitter. The most effective economically feasible measures leading to the reduction of emissions are connected with the reduction of electricity and heating losses, the introduction of steam-gas superstructures in the heating stations and thermo-power stations, the reduction of the share of electric power generated in thermo-power stations using subbituminous or bituminous coal, gasification of the household and public and administrative sector.

Updating legislation and brining it into compliance with European legislation will create conditions for improving and developing these mechanisms. Conditions and schemes will be created to encourage the use of natural gas, of co-generation and renewable energy sources, which will have a beneficial impact on the faster implementation of the project.

[6] *Households' budget in Bulgaria, National Statistics Institute, 2001.*

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

The implementation of the project on Reduction of greenhouse gases by gasification of the towns of Veliko Tarnovo, Gorna Oryahovitsa and Lyaskovets is in accordance with their plans for sustainable development. These plans include gasification, introduction of energy-efficient solutions, improving the air quality and the standard of living.

4.2. Internal Factors

4.2.1. Technical factors

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

These factors are related to the complexity of the engineering development of the project, the lack of background and precise cadastral information about the terrain, lack of modern technologies for engineering activities and high operational costs.

The design is made by means of special software for hydraulic design of facilities, for optimisation and analysing gas distribution networks. The CAD-systems can integrate with geographic information systems /GIS/. "Overgas Engineering" AD uses modern technologies and equipment for laying and welding steel and polyethylene gas pipes. The input materials and equipment meet the requirements of Bulgarian and European standards. The suppliers are leading companies holding ISO 9002 certificate.

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

This group of factors is related to construction and assembly risks, risk in commissioning and possible delay, risk related to obtaining permits to normal operation of the facility.

The major guarantees that the execution risks do not endanger the project implementation are:

- The high professional level of preliminary research of the natural gas market on national and local level;
- The quality of the service provided;
- The precise and high technological level of working designs and construction of urban networks;
- The experience gained.

Conventional, well-known and reliable technologies are used in the gasification of boiler installations, public and office buildings, as well as of housing buildings. Due to these reasons the implementation risk is minimised.

The optimal organisation and the use of modern technologies for trenchless construction of gas distribution networks make construction in densely populated urban area possible without interfering with the daily activities of the population or interrupting the other underground services. The protection of the environment and the remediation of the affected terrain is a required element in the construction and assembly works.

4.2.2. Financial Factors

All Gas Distribution Networks built under the gasification projects are an ownership of the Investor or of the gas distribution company, and all gas installations and internal devices for natural gas are an ownership of the user who made the investment. The project for reduction of greenhouse gases by gasification of the towns of Veliko Tarnovo, Gorna Oryahovitsa and Lyaskovets starts with financing and construction of the gas main branch /GMB/ and the automatic gas regulation stations /AGRS/ for the towns. In principle, the financing and construction of the gas transmission system are the responsibility of the gas transmission company, which in this case is the state owned company "Bulgargas" EAD. An important aspect is the agreement reached with "Bulgargas" EAD, according to which the actual start of the construction of these facilities is fixed to be March 2004, and the construction works are to be completed within four months. Execution thereof will be financed by "Overgas Inc." AD.

Summary

The project fits perfectly in the Energy Strategy of the Bulgarian government. Also the local authorities fully support the project. As a result the legal and administrative preconditions for the project implementation are available.

The funding required for the project implementation will be available. Natural gas will be, during the whole period covered, a source with an attractive price in comparison with other energy sources.

Marketing studies confirmed that, once available, all industrial and public and administrative consumers and most of the household consumers would switch to natural gas.

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

5.1. Baseline selection, specification and calculation of the emissions

Experts from "Energoproekt" AD and Agency for economic analyses and prognoses develop the prognosis for the progress trend of end user energy consumption /EEC/. The general prognosis for EEC progress trend in Bulgaria is worked out in three scenarios – accelerated, moderated and restricted development. The policy on energy efficiency improvement in economy and households is considered in this prognosis.

Scenario	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***2010***	***2011***	***2012***
Accelerated development	11613	11728	12231	12364	12482	12658	12825	13282	13442	13548
Moderate development	11613	11728	12106	12364	12482	12658	12825	13106	13442	13548
Restricted development	11055	10971	11017	11183	11075	11019	10947	10809	11074	10930

Table 3: End energy consumption forecast in the Republic of Bulgaria, thousand ton oil equivalent

According to the marketing survey of "Overgas Inc." AD for the gasification of the towns of Veliko Tarnovo, Gorna Oryahovitsa nad Lyaskovets the structure of energy sources in Bulgaria in 2002 is as follows: 54 % solid fuels, 21 % liquid fuels and 25 % electric power. This structure is supposed to retain the same during the whole period from 2002 up to 2012.

The energy use in 2002 is taken as the departing point of the prognosis of the energy consumption. Also the fuel mix and quantity at that year are taken in consideration. /Table 4/ The wood consumption in the household sector is made on the basis of the expert assessment of "Energokonsilt" AD.

Fuel	***Energy consumption in 2002***		
	Industrial	***Public and administrative***	***Household***
Heavy fuel oil, ton	21000	500	0
Gas oil, ton	2050	3000	470
Subbitominous coal, ton	400	980	23500
Bituminous coal, ton	65000	0	0
Briquette, ton	0	0	35000
Wood, ton	1700	350	14500
LPG, ton	0	0	410
Electricity, GWh	90	75	190

Table 4: Energy consumption in 2002 by fuels and by sectors according to the marketing survey

For development of the baseline of energy consumption "Overgas Inc." AD use the data of moderate development scenario for end energy consumption in Bulgaria. Due to the forecasts of favorable long-term development of the economic situation, underlying this scenario, both parallel and proportional EEC development can be expected on regional and national levels.

The consider two scenarios of the baseline of energy consumption in the three towns is used different growth of energy consumption in the households – conservative /Scenario 1/ and moderated /Scenario 2/. The moderate scenario reports on rise in energy consumption in the household sector due to more favourable influence of the external key factors described in item 4.1. of PDD in comparison with the conservative scenario.

⇒ ***Scenario 1:***

Scenario 1 envisages an average annual growth rate of EEC of 1.21 % over the period 2002 – 2015 and is based on average GDP growth in 2003 of 5.0 % and an annual growth of 5.5 % for the period 2004 – 2007, therefore total energy consumption flexibility with regard to GDP is 0.22. At the same time low inflation rates are projected /3.9 % in the period 2003-2007/, increased population's income by 2012 up to 2.5 % per year and a development of better consumer lending terms. It is assumed that GDP and inflation rates will be stable after 2007.[7] The baseline energy consumption envisages an increase of the consumed energy from 5162 TJ in 2003 to 5704 TJ in 2012 or by 10%. */Table 6/*

⇒ ***Scenario 2:***

Scenario 2 envisages the same economic growth rate as in Scenario 1 /including level of real GDP and inflation rate/. Scenario 2 envisages an average annual growth rate of EEC of 1.27 % over the period 2002 – 2015. The forecasted increase in EEC is due to an increase in the energy consumption in the household sector /with 20% compared to Scenario 1/. This difference in scenarios may by explained by the increase in citizens' income – in Scenario 2 it is by 2.5 or 3 % per year until 2012 with satisfactory development of consumer lending terms and competitive market of the energy sources.

Average annual EEC growth in percents /2003 – 2012/				
Sectors	***Industrial sector***	***Public and Administrative***	***Households***	***All sectors***
Scenario 1	0.76%	2.21%	1.41%	1.21%
Scenario 2	0.76%	2.21%	1.69%	1.27%

Table 5: Average annual EEC growth in percents /2003 – 2012/ by sectors

Total energy consumption for the three towns by years for both scenarios is shown on Chart1.

[7] Projected year for Bulgaria to become an EU member.

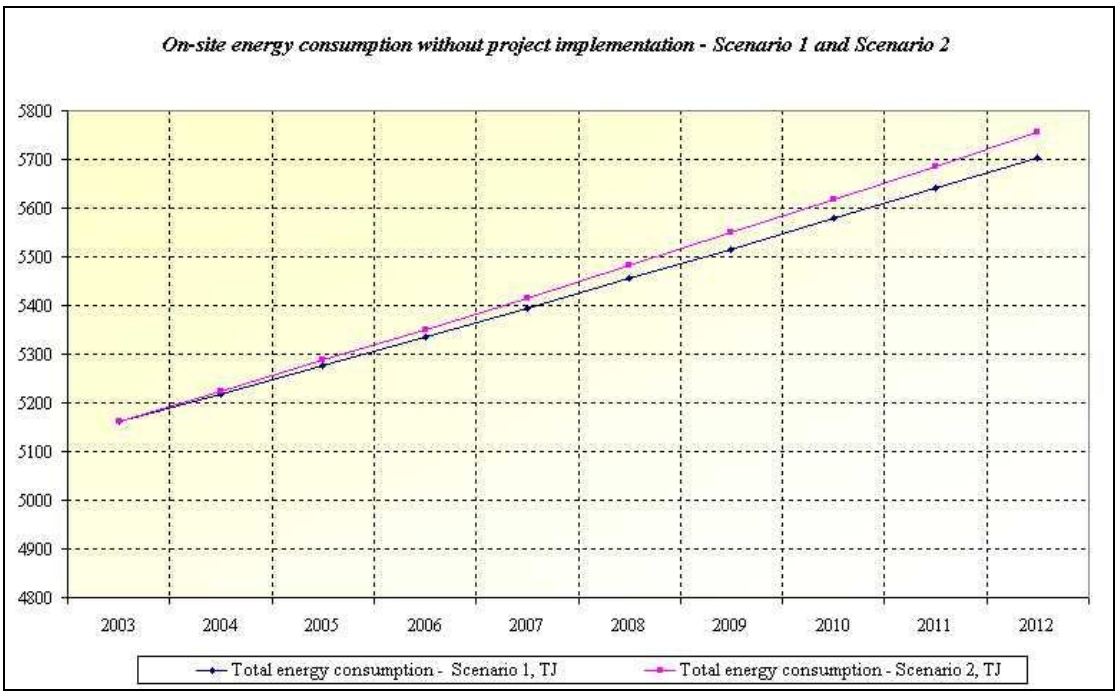

Chart 1: *On-site energy consumption without project implementation - Scenario 1 and Scenario 2*

For the calculation of the end energy consumption and baseline emissions we accept the conservative Scenario 1, which corresponds to more conservative economical development of the region.

The prognosis for energy consumption by energy sources, including losses from transportation, storage and sales for the baseline is presented in Table 6.

	2003	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***2010***	***2011***	***2012***
Heavy fuel oil	864	871	878	885	892	899	906	914	921	928
Gas oil	231	235	239	243	247	251	255	259	263	267
Subbituminous coal	281	285	289	293	298	302	306	311	315	320
Bituminous coal	1658	1670	1683	1696	1708	1721	1735	1748	1761	1774
Briquettes	665	674	684	694	703	713	723	733	744	754
Wood and wood waste	166	168	170	172	175	177	179	182	184	187
LPG	19	19,5	19,7	20,0	20,3	20,6	20,9	21,2	21,5	21,8
Electricity	1278	1296	1314	1333	1352	1371	1391	1411	1431	1451
Total	5162	5219	5277	5336	5395	5455	5516	5578	5640	5704

Table 6: *Energy consumption by energy sources, Scenario 1,TJ*

5.2. 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. The calculation of greenhouse gas emissions is made by using the emission factors shown in *Table 7*.

Fuels	***LHV, TJ/t***	***Source***	***$EF_{CARBON\ DIOXIDE}$, t/TJ***	***Source***
Heavy fuel oil	0.0402	MEW*	0.0774	Vol 2a***
Gas oil	0.0419	MEW	0.0741	Vol 2a
Subbituminous coal	0.0113	MEW	0.0961	Vol 2a
Wood and wood waste	0.0100	MEW	0	Vol 2a
Bituminous coal	0.0255	MEW	0.0946	Vol 2a
Briquettes	0.0190	MEW	0.0961	Vol 2a
Liquid petroleum gas /LPG/	0.0468	IPCC**	0.0631	Vol 2a

Table 7: Emission factors for calculation of greenhouse gases

Note: ***The above used data are taken from:***
** Methods for calculations of the pollutants in the atmospheric air, Ministry of Environment and Water, Sofia, 2000*
*** Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories. Workbook Vol.2*
**** Operating guidelines for project design document of JI Projects, Vol.2a, Annex B1*

In defining the total quantity of emissions of GHG only the emissions of carbon dioxide generating capacities are taken into account. The methane emissions are below 1% and are not included in the total quantity of greenhouse gases.

The growth of energy consumption during the concerned period leads respectively to the increase of the released emissions. The only exception is electricity, which during the years has different emission factors that give an account of the expected increase of the efficiency of power generating installations.

Years	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***2010***	***2011***	***2012***
Bulgaria	948	930	913	896	878	861	844	826	809	792	774	757	740	722

Table 8: Baseline electricity grid CO_2 emission factors for JI projects reducing electricity consumption /in gCO_2/kWh/

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

The total quantity of greenhouse gases emissions for the observed period is shown in *Table 9*.

	2003	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***2010***	***2011***	***2012***
Greenhouse gas emissions – Scenario I, ton $CO_{2\ eqv}$	644660	646250	647774	648858	650237	651542	652385	653529	654591	655165
Greenhouse gas emissions – Scenario II, ton $CO_{2\ eqv}$	644660	646966	649209	651016	653120	655154	656724	658600	660396	661700

Table 9: Total amount of greenhouse gas emissions

The total quantity of greenhouse gas emissions during the observed period reduces at both base lines */Chart 2/*. This is due to electric power use, which represents 25% of the total energy consumption. A gradual reduction of greenhouse gas emissions by 1.6 % or 10 506 tons of CO_2 is observed at scenario 1. At the scenario 2 reduction of greenhouse gas emissions is by 2.6% or 17 040 tons of carbon dioxide.

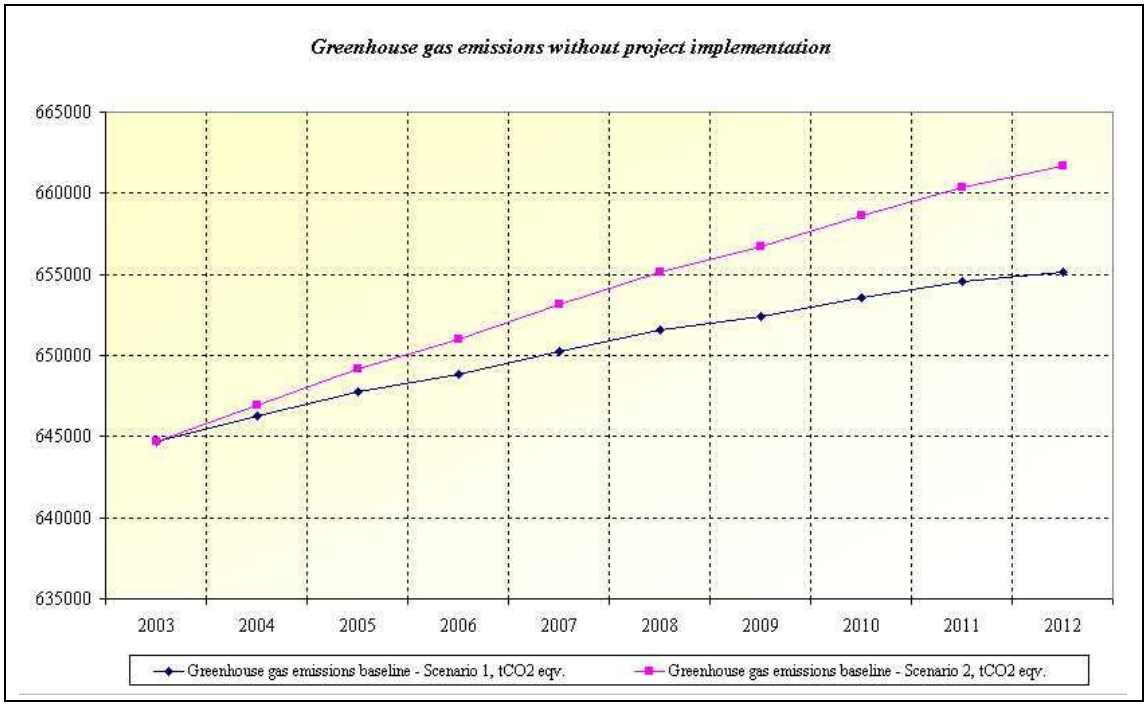

Chart 2: Greenhouse gas emissions without project implementation

Summary

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

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

6. ESTIMATION OF PROJECT EMISSIONS

6.1. Prognoses of natural gas annual consumption

Natural gas market is defined as a complex combination of:
- End users of this energy source;
- 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 the towns of Veliko Tarnovo, Gorna Oryahovitsa and Lyaskovets***

The assessment of the natural gas market is based on summarised data from the inquiries in the industrial and public and administrative sectors carried out by marketing experts of "Overgas Inc." AD and on digital models of the towns and their administrative and territorial planning to town sections.

Consecutive analyses were made on:
- the installation capacities in the heating sources of the industrial and public and administrative sectors; /Annex 4/
- 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 conversion into natural gas as a main source;
- potential level of individual energy consumption per household;
- development of the household sector; /Annex 5/
- range of gasification;
- clients` request and demand.

➢ ***Regional Characteristics***

- ***Industrial sector***

<u>*Veliko Tarnovo*</u>
The industry of the town of Veliko Tarnovo is diversified, however, the competitive position of each company is highly dependent on the trends of development of the international and national industrial markets.

The town enterprises from the light machine building, electronic and electric engineering industries keep a relatively stable production volume. Those enterprises include "Terna" AD, "Vacuumterm" AD, "Bitova elektronika" AD and "Telecommunication processing systems and networks" AD.

Continuous efforts have been applied targeting the promotion of food and beverages and the industry related with processing of agricultural products.

The project envisaged the substitution and rehabilitation of old energy installations in two power-heating stations in the town of Veliko Tarnovo – Central Heating Station /CHS/ Veliko Tarnovo and Regional Heating Station /RHS/ Old Military School.

The base consumers under the Gasification of the town of Veliko Tarnovo Project are – "Toplofikacia VT" EAD, "Velikotarnovsko Pivo" AD and "Darvoobrabotvane" AD. In total those enterprises account for near 71% of the expected sales in the sector.

The project envisaged the gasification of 22 industrial enterprises in the town of Veliko Tarnovo within the period 2004-2012.

Gorna Oryahovitsa
The main industrial sectors in the town are: refined sugar and confectionery production, ceramics, machine-building /incl. manufacturing of trans-manipulators, electric hoists and other storage facilities heating and cooking equipment, tools, machinery assembling tools and details, food and beverages, canning and textile industry, household chemical products for wide consumption, etc.

The base consumers under the Gasification of the town of Gorna Oryahovitsa are – "Zaharni Zavodi" AD, Locomotive Depot and Ceramic Factory "Mizia". The largest industrial enterprise in the region is "Zaharni Zavodi" AD, which has undergone serious economic difficulties over the last 2-3 years due to the changed market conjuncture. The realistic scenario for this project envisages rehabilitation of part of the manufacturing lines, though in a rather reduced manner. The above three enterprises account for near 62% of the potential sales in the sector.

The project envisages the gasification of 17 industrial enterprises in the town of Gorna Oryahovitsa within the period 2004-2012.

Lyaskovets
The production capacities of Lyaskovets make the town an industrial centre of more than municipal importance. The enterprises, which play a structural role in the economy of the municipality, according to their production capacities and the number of employees, are machine building and food and beverages branches of industry.

Some of the large enterprises on the territory of Lyaskovets are:
- Arkus AD – special production plant, spare parts, gas revolvers;
- Balance AD – the largest Bulgarian manufacturer of measuring equipment, dozing systems and weighting equipment;
- FMA AD –manufacturer of metal packaging, caps type "Omnya", varnishing and lithography of alumnae sheets, etc.
- Vineyard Lyaskovets 1934 AD – time-honoured producer of high-quality wines, strong drinks and grapes brandy.

The above 4 enterprises are included in the Gasification of the town of Lyaskovets Project as potential users of natural gas. The largest energy consuming among them is FMA AD factory, which accounts for 51% of the potential natural gas consumption of the town.

- ***Public and administrative sectors***

There are three universities, higher education military school, vocational schools specialised in different fields and large number of primary and secondary schools, and kindergartens in the area.
The commercial activity in the three towns is realised through: public catering, chain of food and other shops, markets, service studios, offices. The municipality of Veliko Tarnovo and the surrounding area has good tourism opportunities. The favourable climate, the existence of natural and historical landmarks and the development of traditional art crafts premise the development of rest and recreation, sport and tourism activities during the whole year.

The project envisages the gasification of 83 public and administrative and commercial buildings. The small commercial units located in residential buildings and small premises are included as potential consumers under the household sector. This is due to the type of their business activity, specific conditions of natural gas supply, as well as due to the energy supply alternatives.

- ***Household sector***

By 31.12.2001 the population of the towns of Veliko Tarnovo, Gorna Oryahovitsa and Lyaskovets amounts to 111 728 residents grouped in 39 903 households.

The town of Veliko Tarnovo has its own central heating infrastructure. The Project for Gasification of the town of Veliko Tarnovo envisages the gasification of Toplofikacia VT EAD – Central Heating Station and Regional Heating Station. The CHS is designed for central heating of Kolyo Ficheto TS and Buzludzha TS, and RHS – for the central town section South. 13 600 residential houses, incl. 7 900 residential buildings, occupied by 31% of the total population and 5 760 "provisional" houses, registered as commercial units, are on central heating. The residential buildings, which are already included in the central heating system, are not taken into consideration for the household sector estimations.

The project envisages the gasification of over 17 600 households, which covers 45% of total households on the territory of the three towns.

➢ ***Predicted annual consumption***

It is anticipated that the following consumers will be included in the gas supply system within the investment project period:
- Industrial enterprises – 43;
- Public and administrative buildings – 83;
- Residential buildings – over 17 000 households.

The analysis of the regional gas market for the three towns shows that the realistic annual sales projections at the end of the period, grouped by sectors are as follows:

• Industrial sector	31.54 million/sm^3
• Public and administrative sector	6.20 million/sm^3
• Household sector	26.58 million/sm^3
TOTAL	**64.32 million/sm^3**

The predicted number of the end users and annual consumption of natural gas made by towns and by sectors is represented in *Annex 6.*

6.2. Description of the emissions calculation method

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

The total project emissions is influenced by the following factors:
- Total 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 will be specified by the end-user sectors.

➢ ***Input data***

The energy use in three towns in 2002 is taken as the departing point of the prognosis of the energy consumption. Also the fuel mix and quantity at that year are taken in consideration. /Table 4, item 5.1 of PDD/

The prognoses of energy consumption by sectors with the project implementation are the accepted one in Scenario 1 /item 5.1 of PDD/ in the baseline calculation. It's expected that the annual growth rates are constant over the whole project period.

In the calculation is used an Energy efficiency factors by sectors and energy sources /Table 10/ and Conversion efficiency factor of natural gas equivalent to the substituted fuels by energy sources and by sectors /Table 11/.

The combustion installations of the end-users include over 110 numbers of boilers, which differ by type, efficiency and rate of amortization.
Heavy fuel oil - the operating efficiency factor for the small boilers KM12 using heavy oil varies between 0.75 and 0.82, according to the data from end-users. The operating efficiency factor for the big boilers of type VK /"Toploficacia VT" AD/ varies between 0.78 and 0.86. In view of the fact that the half of the consumed quantity of heavy oil is used in small boilers, in the calculations for heavy oil combustion installations it's assumed weighted average efficiency factor 0.8 in industrial sector and 0.75 in public and administrative sector.
Gas oil - the efficiency factor for the boilers using gas oil is assumed 0.88 in the industrial and public and administrative sectors and 0.8 in household sector.

Solid fuels /coal, briquettes and wood/ - the efficiency factor for fire-grate boilers using solid fuel in the household and public and administrative sectors is too low 0.65-0.7. The efficiency factor for coal-fired boilers of HES "Zaharni zavodi" is 0.85 as an exception.
Natural gas - in all combustion installations after gasification is assumed efficiency factor 0.9. On the basis of these data the conversion factors for different fuels in different sectors are estimated and represented in Table 11.
Electricity – for the electricity used for cooking, HWB and heating as efficiency factor is assumed 0.95.

	Industrial	***Public and Administrative***	***Households***
Heavy fuel oil	0,80	0,75	not used
Gas oil	0,88	0,88	0,80
Subbituminous coal	0,70	0,70	0,65
Wood and wood waste	0,65	0,65	0,65
Bituminous coal	0,85	0,85	0,65
Briquettes	not used	not used	0,65
LPG	0,90	0,90	0,89
Electricity	0,95	0,95	0,95
Natural gas	0,90	0,90	0,90

Table 10: Energy efficiency factors[8].

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

$$\frac{(LHV_{fuel},\ TJ/t)*Eff.\ facor_{com.\ inst.}}{(LHV_{natural\ gas},\ TJ/sm^3)*Eff.\ facor_{natural\ gas.}}$$

Where:

LHV_{fuel}, [TJ/t] Low heating value of the substituted fuel;
Eff. $facor_{com.\ inst.}$ - Energy efficiency factors of the combution installation befor gasification;
$LHV_{natural\ gas}$, [TJ/sm^3] - Low heating value of natural gas;
Eff. $facor_{natural\ gas.}$ Energy efficiency factors of the combution installation after gasification.

Conversion efficiency factors for different energy sources	***Dimension***	***Iindustrial sector***	***Public and administrative sector***	***Household***
Heavy fuel oil	sm^3/t	0.985	0.985	-
Gas oil	sm^3/t	1.205	1.205	1.095
Subbitominous coal	sm^3/t	0.258	0.258	0.240
Bituminous coal	sm^3/t	0.708	0.708	0.542
Briquette	sm^3/t	-	-	0.404
Wood	sm^3/t	0.212	0.212	0.212
LPG	sm^3/t	1.376	1.376	1.361
Electricity	sm^3/MJ	111.76	111.76	111.76

Table 11: Conversion efficiency factor by energy sources and by sectors

8 *"Energy directory", vol. 8, I and II part, ABC Technika Publishers, edited by Prof. Stoyan Stoyanov and Ass. Prof. Nikola Kaloyanov.*
Heating, conditioning and cooling directory, II Part - Heating, heat and gas supply, Technika Publishers Ltd., Prof. PhD Stancho Stamov, Prof. PhD Konstantin Shushulov and other contributors.
Expert judgement made by "Energoconsult" AD.

During the observed period, natural gas will gradually replace solid and liquid fuels used in industry, the public and administrative sector and households. Initially, the large industrial enterprises which use predominantly heavy fuel oil, and the municipal facilities which use mainly gas-oil will be connected to the gas network. Within four years from the beginning of the gasification, heavy fuel oil and a large part of the gas-oil will be almost entirely replaced. Replacement of solid fuels will be a relatively slower process, because the predominant users are households, where gasification requires longer period.

The expected annual consumption of natural gas and the other fuels during the project implementation is shown in Table 12, Table 13, and Table 14 and is calculated as follows:

- Determination of the fuels' amounts replaced by natural gas by sort of the fuel and by sectors;
- Calculation of the quantity of natural gas equivalent to each replaced fuel, by multiplying the quantity of replaced fuel by conversion efficiency factor from Table 11;
- Calculation of fuels quantities by sectors, as a difference between fuels quantity without project implementation and the amount of the replaced fuels;
- Calculation of the project emissions released from the end users' combustion installations.

Industrial sector	***user units***	***utilisation***	***remaining / resulting utilisation***								
		2003	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***2010***	***2011***	***2012***
Heavy fuel oil	ton	21000	16216	4051	2233	300	300	300	300	300	200
Gas oil	ton	2050	850	619	400	30	15	15	15	15	15
Subbitominous coal	ton	400	300	200	150	0	0	0	0	0	0
Bituminous coal	ton	65000	65000	65000	65000	64000	64000	64000	64000	64000	64000
Briquette	ton	0	0	0	0	0	0	0	0	0	0
Wood	ton	1700	450	300	250	20	0	0	0	0	0
LPG	ton	0	0	0	0	0	0	0	0	0	0
Electricity	GWh	90	91	91	91	90	90	90	89	88	87
Natural gas	**1000 m^3**	**0**	**7305**	**21012**	**23836**	**27852**	**28509**	**29150**	**29906**	**30668**	**31540**
Heavy fuel oil	TJ	844	652	163	90	12	12	12	12	12	8
Gas oil	TJ	86	36	26	17	1	1	1	1	1	1
Subbitominous coal	TJ	5	3	2	2	0	0	0	0	0	0
Bituminous coal	TJ	1658	1658	1658	1658	1632	1632	1632	1632	1632	1632
Briquette	TJ	0	0	0	0	0	0	0	0	0	0
Wood	TJ	17	5	3	3	0	0	0	0	0	0
LPG	TJ	0	0	0	0	0	0	0	0	0	0
Electricity	TJ	324	326	328	328	324	324	324	320	317	313
Natural gas	**TJ**	**0**	**248**	**714**	**810**	**947**	**969**	**991**	**1017**	**1043**	**1072**
Total	**TJ**	**2933**	**2928**	**2894**	**2906**	**2916**	**2938**	**2960**	**2982**	**3004**	**3026**

Table 12: Distribution of used energy sources in industrial sectors of the three towns

Public and administrative sector	***user units***	***utilisation***	***remaining / resulting utilisation***								
		2003	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***2010***	***2011***	***2012***
Heavy fuel oil	ton	500	511	350	300	0	0	0	0	0	0
Gas oil	ton	3000	3066	3070	2370	500	400	250	250	150	100
Subbitominous coal	ton	980	1002	990	990	900	800	600	400	200	150
Bituminous coal	ton	0	0	0	0	0	0	0	0	0	0
Briquette	ton	0	0	0	0	0	0	0	0	0	0
Wood	ton	350	358	350	260	250	150	100	0	0	0
LPG	ton	0	0	0	0	0	0	0	0	0	0
Electricity	GWh	75	77	77	77	77	77	79	78	81	80
Natural gas	**1000 m^3**	**0**	**0**	**410**	**1618**	**4495**	**4971**	**5307**	**5815**	**5982**	**6504**
Heavy fuel oil	TJ	20	21	14	12	0	0	0	0	0	0
Gas oil	TJ	126	128	129	99	21	17	10	10	6	4
Subbitominous coal	TJ	11	11	11	11	10	9	7	5	2	2
Bituminous coal	TJ	0	0	0	0	0	0	0	0	0	0
Briquette	TJ	0	0	0	0	0	0	0	0	0	0
Wood	TJ	4	4	4	3	3	2	1	0	0	0
LPG	TJ	0	0	0	0	0	0	0	0	0	0
Electricity	TJ	270	276	277	277	277	277	284	281	292	288
Natural gas	**TJ**	**0**	**0**	**14**	**55**	**153**	**169**	**180**	**198**	**203**	**221**
Total	**TJ**	**430**	**440**	**449**	**457**	**464**	**474**	**483**	**493**	**504**	**515**

Table 13: Distribution of used energy sources in public and administrative sectors of the three towns

Households	***user units***	***utilisation***	***remaining / resulting utilisation***								
		2003	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***2010***	***2011***	***2012***
Heavy fuel oil	ton	0	0	0	0	0	0	0	0	0	0
Gas oil	ton	470	477	400	50	50	50	50	50	50	50
Subbitominous coal	ton	23500	23831	22000	9100	4780	4500	4100	3500	3100	3100
Bituminous coal	ton	0	0	0	0	0	0	0	0	0	0
Briquette	ton	35000	35494	31150	19500	6400	5700	5200	4700	4500	4100
Wood	ton	14500	14704	14600	8100	5100	4700	4100	3800	3500	3100
LPG	ton	410	416	400	50	50	50	50	50	50	50
Electricity	GWh	190	193	195	194	193	192	191	190	192	192
Natural gas	**1000 m^3**	**0**	**0**	**2662**	**13512**	**21249**	**22469**	**23689**	**24902**	**25622**	**26580**
Heavy fuel oil	TJ	0	0	0	0	0	0	0	0	0	0
Gas oil	TJ	20	20	17	2	2	2	2	2	2	2
Subbitominous coal	TJ	266	269	249	103	54	51	46	40	35	35
Bituminous coal	TJ	0	0	0	0	0	0	0	0	0	0
Briquette	TJ	665	674	592	371	122	108	99	89	86	78
Wood	TJ	145	147	146	81	51	47	41	38	35	31
LPG	TJ	19	19	19	2	2	2	2	2	2	2
Electricity	TJ	684	694	703	698	695	691	688	684	691	691
Natural gas	**TJ**	**0**	**0**	**91**	**459**	**722**	**764**	**805**	**847**	**871**	**904**
Total	**TJ**	**1798**	**1824**	**1816**	**1717**	**1648**	**1666**	**1684**	**1702**	**1722**	**1743**

Table 14: Distribution of used energy sources in households of the three towns

6.3. Estimation of the total projected emissions

Direct on-site emissions include:

- emissions from the burning of various fuels in the combustion installations of the end users;
- emissions from reduced consumption in result of improved energy efficiency;
- emissions from reduced consumption in result of elimination of losses from heating and transport of heavy fuel oil, as well as transport and storage of solid fuels.

The greenhouse gas emissions calculations were made by the use of carbon emission factor taken form IPCC and the calculated carbon dioxide emission factor.

Fuel	***Carbon and carbon dioxide emission factors***	
	Carbon emission factor, tC/TJ	***Carbon dioxide emission factor, tCO_2/TJ***
Heavy fuel oil	21.2	77.4
Gas oil	20.2	74.1
Subbitominous coal	26.2	96.1
Bituminous coal	25.8	94.6
Briquette	26.2	96.1
Wood	-	0
LPG	17.2	63.1
Electricity	-	722 – 878

Table 15: Carbon and carbon dioxide emission factors by fuels

On the basis of the prognoses fuel consumption during project implementation /Table 12, Table 13 and Table 14/ and the emission factors /Table 15/ the amounts of greenhouse gas emissions are calculated by sectors and by years. Table 16 presents data for the greenhouse gas emissions for the period 2008-2012.

Sector / ***Year***	***Carbon dioxide emission with project implementation, t_{CO2}***			
	Industrial sector	***Public and administrative sector***	***Household***	***Total***
2008	281026	72577	210518	564121
2009	280627	72696	207267	560591
2010	279784	71347	204014	555145
2011	278984	72032	202836	553852
2012	278029	70639	200478	549147

Table 16: Carbon dioxide emission upon project implementation by years and sectors

For reasons of modern construction technologies implementation, lack of worn out gas distribution networks and internal installations the losses from transportation of natural gas by pipeline branches, gas distribution network and utilisation by end-consumers are insignificant.

Summary

- The penetration of natural gas follows the scenario as developed in the marketing reports as given in it.1.4 of PDD;
- Upon implementation natural gas will be used for the production of heat;
- The use of electricity for power, cooling and lighting will be constant;
- The energy consumption follows the economic growth rate /Scenario 1 at the conservative economic growth/;
- The carbon dioxide emission factor for the electricity production will develop according to the Senter Internationaal data;
- The carbon dioxide emission factor for all other energy commodities will be unchanged.

7. CREDITING TIME

Starting date of feasibility study:	1998
Starting date of construction:	01.03.2004
Life time of the project:	According to the terms of granted licenses – 20 years with an option for 10 years extension.
Crediting time of the project	Five years, equivalent to the engagement period from 2008 to 2012.

8. ESTIMATION OF EMISSION REDUCTION

8.1. Emission reductions

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

The results are presented in *Table 17.*

	2003	***2004***	***2005***	***2006***	***2007***	***2008***	***2009***	***2010***	***2011***	***2012***
Baseline GHG emissions, Scenario 1,tCO_{2eqv}	644660	646250	647774	648858	650237	651542	652385	653529	654591	655165
GHG emissions with project implementation, tCO_{2eqv}	644660	639724	619074	593644	568591	564121	560591	555145	553852	549147
ERUs, tCO_{2eqv}	0	6526	28700	55214	81646	87421	91794	98384	100739	106018

Table 17: Reduction of emissions with project implementation

A reduction of **484 356** emissions units will be achieved with project implementation during the period 2008-2012.

In this amount are not included the emissions of dinitrogen oxide, which are about 15000 units tCO_{2eqv} and the expected reduced emissions and result of co-generation implementation in "Toplofikatsia VT" EAD.

The total amount of claims on ERUs to be procured in the period 2008 – 2012 is 400 000 ERUs. /83 % of the total in the period/.

8.2. Effective emission reduction factors

The preceding chapters estimate the annual consumption of natural gas and the resulting reduction in the carbon dioxide emissions for each sector. By dividing the emission reduction by the natural gas consumption, a factor is obtained quantifying the efficiency of the fuel switch from carbon rich fossil fuels to natural gas in a real environment. This factor is designated by "Effective emission reduction factor" /EERF/ and will be an essential tool in the monitoring procedure. A useful dimension of the EERF is $tCO_{2eqv}/ 1000\ sm^3$.

The EERF depends on the local energy utilisation patterns as the traditional fuel mix, switched applications and specific energy consumption. Table 18 shows the EERF by end-user sector and year. Table 19 shows the EERF by year for the overall project.

	Natural gas consumption, thousand sm^3	***Emission reduction, tCO_{2eqv} /ERU/***	***Effective emission reduction factor, tCO_{2eqv}/thousand sm^3***
Industrial sector			
2008	28509	30777	1.08
2009	29150	31850	1.09
2010	29906	33455	1.12
2011	30668	35010	1.14
2012	31540	36617	1.16
Public and Administrative sector			
2008	4971	6996	1.41
2009	5307	7096	1.34
2010	5815	8723	1.50
2011	5982	8289	1.39
2012	6504	9813	1.51
Household sector			
2008	22469	49649	2.21
2009	23689	52848	2.23
2010	24902	56206	2.26
2011	25622	57440	2.24
2012	26580	59589	2.24

Table 18: Effective emission reduction factors by sector and year.

	Natural gas consumption, thousand sm^3	***Emission reduction, tCO_{2eqv} /ERU/***	***Effective emission reduction factor, tCO_{2eqv}/thousand sm^3***
All sectors			
2004	7305	6526	0.89
2005	24085	28699	1.19
2006	38966	55214	1.42
2007	53595	81647	1.52
2008	55950	87421	1.56
2009	58145	91794	1.58
2010	60623	98384	1.62
2011	62271	100739	1.62
2012	64624	106019	1.64

Table 19: Effective emission reduction factors in the overall project by year.

9. MONITORING PLAN

9.1. Main principles

- For control and determine of 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 effective emission reduction factor for converting of natural gas sales in emission reduction units as defined in item 8 of the PDD is used;
- The effective emission reduction factors include the fuel switch effect and reduced energy consumption due to the increase of the efficiency of the burning installations.
- In the calculation of the total amount of realised ERUs are included natural gas sales in the three sectors, and the realised emissions reduction from the project is defined;
- Based on the realised emissions reduction the contractual emission reduction units are determined.

This approach is justified due to the following facts:

- At the start of the project there is no consumption of natural gas;
- All natural gas is replacing the currently used fuels;
- In absence of this project the end-users would use the non-natural gas fuels.

9.2. Calculation of the realised greenhouse gas emissions reduction

The calculation of the realized emissions reduction is made by multiplying the sum of sold amount of natural gas to all end users in each sector by effective emission reduction factor

Year	***Natural gas consumption, thousand sm^3***	***Effective emission reduction factor, tCO2/thousand sm^3***	***Carbon dioxide emission reduction /ERUs/, tCO_2***
Industrial sector			
2008		1.08	
2009		1.09	
2010		1.12	
2011		1.14	
2012		1.16	
Public and administrative sector			
2008		1.41	
2009		1.34	
2010		1.50	
2011		1.39	
2012		1.51	
Household sector			
2008		2.21	
2009		2.23	
2010		2.26	
2011		2.24	
2012		2.24	

Table 20: Calculation of the realized greenhouse gas emissions reduction

9.3. The activities responsibility, providing for monitoring

"Rahovetsgas 96" AD will collect the data for buying quantities and will report on month sales of natural gas 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.

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

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

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

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 *Annex 8* a detailed information about the automatic dispatcher system is presented.

The data collected to perform the monitoring of the emissions from the project activity and the methods of measurement that will be applied are shown in *Annex 9*.

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

For monitoring implementation as is described in it.9.1, as an indicator will be used annual natural gas consumption by sectors. The methods for determination of the consumed natural gas quantities are presented in *Annex 10*.

Summary

The monitoring plan is based on observation of the main factor – quantity of natural gas consumption.

The volumes of consumed natural gas by sectors are initial data for estimation of the realised reduction of greenhouse gas emissions.

The monitoring results will serve like a basis for reporting about submitted ERUs, as well as for the validation by independent body of the quantities realised ERUs.

The method and the succession of monitoring are clear and are a guarantee for obtaining trustworthy and reliable results.

10. STAKEHOLDER COMMENTS

"Overgas Inc." AD has intensive contacts with all stakeholders involved in the project.
Requirements for the construction of gas transmission and distribution networks within and outside urbanised territories are set out and controlled by a number of laws, regulations to them, ordinances and other regulatory instruments. By virtue of these documents on every stage of the regulated in them procedures stakeholders are strongly engaged. They can be divided in the following groups:

- Authorities, including the municipal administration;
- Professional organisations, specialised government control bodies and communal companies;
- Non-governmental organisations;
- The General public.

- For example the public was informed about the elaboration of the schemes of gasification of the towns of Veliko, Tarnovo, Gorna Oryahovitsa and Lyaskovets by announcement in the State Gazette.
  There are not objections or negative opinions on the content of the schemes. The mayors of the three municipalities issued an order for the approval of the gasification schemes.

- The working projects for gasification of the towns of Veliko Tarnovo, Gorna Oryahovitsa and Lyaskovets are coordinated with the control bodies – State Technical Supervision, Regional Fire Defense, Hygiene and Epidemiology Inspectorates, Civil Defense and interested communal companies - Electric Power Distribution, Water Supply and Sewerage, Bulgarian Telecom, Linear Cable Company, Irrigation Systems, Roads Execution Agency, Bulgarian Railways who didn't have got negative position on the projects. The coordinated project documentation is approved by the relevant Municipalities and for the town of Veliko Tarnovo has been obtained a design visa and for the towns of Gorna Oryahovitsa and Lyaskovets - construction permits.

- Under **the Act on Protection of Farm Land there is a procedure** on which after the full preparation of the note on the route choice the opinion of the municipal administration, control bodies and communal companies has been taken into account. These positions have been obtained and support the investment intention. The Expert Boards on the arrangement of the territory at the municipal administration approved the affirmed route variants and the mayors issued an order after establishment of absence of public objections.

- **The procedure in accordance with the Environment Protection Act enables a large number of interested people to give their opinion in relation to the project implementation.** The stages of the procedure are as follows:

- Licensed independent experts prepare an Environment Impact Statement for the site;
- An announcement is published in the local press to inform the public of the developed report and a date is fixed for its public discussion;
- A public discussion is held – the population of the town is informed about the project and the stakeholders express their opinion in a discussion.
- In case of absence of any objections /as is the case with the projects in Veliko Tarnovo, Gorna Oryahovitsa and Lyaskovets/ the Expert Board of the competent body – Regional Inspectorate of Environment and Waters approves the EIS and issues permits for project implementation.

The environmental policy of "Overgas Inc." AD adhere to a practice of inviting to the public hearings not only the institutions concerned by the Environment Protection Act but also representatives of non-governmental organizations, scientific institutions, and managers of large enterprises that are expected to switch to natural gas as part of the project. The aim is to make the project intentions known to broader sections of the public, to demonstrate the advantages of the use of natural gas that substitutes solid and liquid fuels, and to take into account the considerations of interested social groups.

The public discussion of the Environment Impact Statements were held as follows:

⇒ **For the project "Gasification of the town of Veliko Tarnovo"** - it was held on the 09.02.1999 – 29 persons attended it: the Municipality Mayor and experts, representatives of the independent ecological organisation, mangers of different companies /"Elmot" AD, ET "Demo", VRZ "Ivailo"/, citizens, representative of "Overgas Inc."AD, "Rahovetsgas" AD, independent experts, representatives of research organisations /Bulgarian Acamedy of Science – Water problems institute/. A film for the processes of gasification and the activities during the implementation and exploitation of the project was presented. The director of Marketing Department of "Overgas Inc." AD introduced the project and the independent experts – the Environment Impact Statement. There was a question about the possibility for simultaneous construction of water pipes and gas pipelines and the reply from the representative of the Investor was that this is the practice in a many countries but that in Bulgaria the two kinds of pipelines are constructed under different legislative decrees and are in different permission regimes. The questions of the stakeholders were related mainly to the specification of the speed of realisation of the project. The statements showed positive attitude to the project for gasification and desire for its faster implementation. There were no opinions with negative reactions concerning the project.

On the basis of the implementation of the public discussion and meeting of the Expert ecological council the Director of the Regional Inspectorate of Environment and Waters – Veliko Tarnovo issued a decision on the environment impact assessment of the project "Gasification of the town of Veliko Tarnovo" by which the implementation of the project is permitted. /annex 12/

⇒ **For the project "Gasification of the town of Gorna Oryahovitsa"** - it was held on the 07.12.2003, with 24 representatives of the following organisations: Municipality of Gorna Oryahovitsa, Regional Inspectorate of the Environment and Waters, Independent Experts, "Overgas Inc." AD, designers of the project, non-governmental ecological organisations /Ecoforum for Peace, Political party of greens, Balkan Ecological Federation/, local enterprise managers and citizens. The project was introduced to the presented, the designers made explanations, the independent experts worked the Environment Impact Statement had represented the environmental impact assessment. The questions discussed concerned the safety of the appliances working on natural gas and the term for network construction. There was a question about the compatibility between the gas distribution network and other communications. It was explained that a full sketch of all the communication in the territory had been made before creating the working design for the project and after that the gas distribution network was taken in and went through the co-ordination procedures provided for the legislation. It was noted that after the gasification implementation there would be no need for slag storage, which would be favourable for the territories around the enterprise for sugar. As a conclusion a positive impact of the project was discussed and recommendations to the Expert ecological council were made for a positive decision on the report.

On the basis of the implementation of the public discussion and meeting of the Expert ecological council the Director of the Regional Inspectorate of Environment and Waters – Veliko Tarnovo issued a decision on the environment impact assessment of the project "Gasification of the town of Gorna Oryahovitsa" by which the implementation of the project is permitted. /Annex 15/

⇒ **For the project "Gasification of the town of Lyaskovets",** held on 05.01.1999, 26 people participated: the Municipality Mayor, Expert from the Municipality responsible for Environment Impact Assessment, members of the Architectural Town Planning Commission, representatives of independent ecological organisations /Balkan Ecological Federation, Political party of greens, Ecoforum for Peace/, enterprises managers, citizens, representatives of "Overgas Inc." AD, "Rahovetsgas" AD, independent experts. A film demonstration showed the process of construction and exploitation of the gas networks. The team leader of the independent experts who had prepared the Environment Impact Statement summarised the assessment and the conclusions. Questions were asked concerning the odour of natural gas, and it was explained that it is obligatory to odourise natural gas used in households with mercapthanes that give it a specific smell and is easier to find leakages. A procedure for assignment of a place for waste storage during the construction process was explained and the price for switching to natural gas for one household was discussed. The questions of the representatives of the enterprises were about the clarifying of the terms for including the enterprises. A desire was expressed for the faster finishing of the preparation for receiving a permit to implement the project. Information about the ecological benefits of the substitution of conventional fuels for natural gas was also presented during the discussion.

On the basis of the implemented public discussion and the meeting of the Expert ecological Boards the Director of Regional Inspectorate of Environment and Waters – Veliko Tarnovo gave a permit on the Environment Impact Assessment for the project "Gasification of the town of Lyaskovets" and allowed the project implementation /Annex 18/.

The procedure on the report on the stakeholders comments under **the Waters Act** is the same as that under the Environment Protection Act – the licensed independent experts developed an ecological analysis with which they wanted to attest an absence of any long-lasting effects on water sites when crossed by gas pipelines.

The Investor declared his intentions before the competent authorities – Basine Directorate with the MEW. The competent authority informs the population of the town of the application field. Under this procedure there are not any objections or negative positions on the crossing of water site during the construction of the gas distribution network on the territory of the town of Veliko Tarnovo.

The submitted in Project Idea Note references to "Overgas Inc." AD and all project partners present the positive attitude towards the project and the convenience in the potential of "Overgas Inc." AD to implement the project.

Summary

According to all listed procedures, including a possibility of receiving comments and opinions from the stakeholders – citizens, municipal administration, specialised government control bodies and communal companies, experts from researching organisations – no objections have been received for the project implementation. The three towns were interested in faster project implementation, positive public attitude to the projects for gasification, information about the economical, social and ecological benefits for the region and for each end user.

11. ENVIRONMENTAL IMPACT

The project's impact on the environment is examined in the Environment Impact Statements /EIS/ prepared by independent experts in compliance with the existing Bulgarian legislation regarding permits to the implementation of the project at that time. */Annexes 11, 14, 17/*

The respective decisions of the controlling body, namely the Regional Inspectorate of Environment and Waters /RIEW/, are positive for all the statements and are attached to them. The permit regarding the Environment Impact Assessment /EIA/ has been extended in compliance with the legislation in view of the project's implementation. /Annexes No. 12, 15, 18, 13, 16, 19/

The three reports examine the environment impact of gasification in the three towns – Veliko Tarnovo, Gorna Oryahovitsa and Lyaskovets – during the construction and exploitation of the gas distribution network. Two hypotheses have been reviewed: 1st – the existing situation /use of conventional fuels/, without the project implementation and the 2nd – gasification of the industrial, public and administrative and household sectors, described and assessed the impact of the gasification on the population, biodiversity with its elements, incl. flora and fauna, soils, water, air, climate and landscape, earth grounds and material and cultural heritage and their interaction.

Summary of the Environment Impact Statement on the project "Gasification of the town of Veliko Tarnovo"

- The investigations of the independent experts in the report show that, with the introduction of natural gas as an energy source in the town of Veliko Tarnovo, the specific composition of emissions from the end users' combustion installations has been changed. There has been a considerable reduction of greenhouse gases, removing of the emissions of sulphur oxides and dust, and a reduction in the total amount of noxious emissions of 7.6 times. There are shown advantages of natural gas in comparison with the solid and liquid fuels and the actuality of the project for the environmental improvement in the town of Veliko Tarnovo. Based on the used contemporary methods for prognosis and modeling - paying attention to the tendencies in the town's development, it is clear that the construction and exploitation of the project will have no negative impact on the environment, will improve the air and living conditions, and will be favourable to its sustainable development.

Summary of the Environment Impact Statement on the project "Gasification of the town of Gorna Oryahovitsa"

- The independent experts, based on their analysis reported that the introduction of natural gas as an energy source in the town of Gorna Oryahovitsa reduces the total emissions amount from the end users combustion installations 13.2 times. The reduction of greenhouse gases is considerable, the emissions of sulphur oxides and dust are virtually eliminated. The report reviews the advantages of natural gas compared to the solid and liquid fuels and the actuality of the project for the environmental improvement in the town of Gorna Oryahovitsa. The report proves that the construction and exploitation of the project will not have a negative impact on the environmental components. The quality of the air will be improved considerably, which will lead to an increase in the living standard and comfort of the working environment and an improvement in people's health due to the reduction of some diseases.

Summary of the Environment Impact Statement on the project "Gasification of the town of Lyaskovets"

- The report presents assertive evidence that the introduction of natural gas as an energy source in the town of Lyaskovets will lead to a 10 time reduction of the total emissions amounts from the end users combustion installations. There will be a considerable reduction of greenhouse gases and a full elimination of the emissions of sulphur oxides and dust. The advantages of natural gas in comparison with solid and liquid fuels, and the actuality of the project for the environment improvement in the town of Lyaskovets are discussed. The report proves that the construction and exploitation of the project will not have a negative influence on environment components. Using contemporary methods for prognosis and modeling, and taking into account the current tendencies in the town's development in the report is shown that the air conditions in the town of Lyaskovets will be improved dramatically. This will have a positive impact on all environmental components, will improve the working conditions and living comfort of the population and will have a long-lasting positive impact on health.

Summary

The conclusions of the independent experts who prepared the environment impact statements, provide strong evidence for **the lasting positive impact** of the substitution of solid and liquid fuels for natural gas on the environment components and people's health and estimate the project as social and environmental.
The received positive decisions on the environmental impact statements were of great importance for receiving of the construction permits.

ABBREVIATIONS USED IN THE DOCUMENT:

AGRS	Automatic Gas Regulation Station
CHS	Central Heating Station
CO_2	Carbon Dioxide
CO_{2eqv}	Carbon Dioxide Equivalents
DFI	Direct Foreign Investments
EEC	End Energy Consumption
EEEA	Energy and Energy Efficiency Act
EF	Emission Factor
EIA	Environment Impact Assessment
EIS	Environment Impact Statement
ERU	Emission Reduction Unit
EU	European Union
GDN	Gas Distribution Network
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GIS	Geographic Information Systems
GMB	Gas Main Branch
GSM	Global System for Mobile Communication
HWB	Hot Water Boilers
IHD	Index of Human Development
IMF	International Monetary Fund
IPCC	Intergovernmental Panel on Climate Change
JI	Joint Implementation
LTA	Long-term Tangible Assets
MEW	Ministry of Environment and Waters
NEC EAD	National Electric Company EAD
PDD	Project Design Document
PE-HD	Polyethylene High-density
RHS	Regional Heating Station
RIEW	Regional Inspectorate of Environment and Waters
SERC	State Energy Regulatory Commission
SME	Small and Medium Enterprises
SMS	Short Message Service
UNFCCC	United Nations Framework Convention on Climate Change