<THE IMPORTANCE OF CONNECTING SMALL TO MEDIUM-SIZED CITIES IN THE RUSSIAN FEDERATION TO THE NATURAL GAS GRID>

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ABSTRACT

Most small to medium-sized cities in the Russian Federation are not yet connected to natural gas networks, which means they have to burn “masut” (heavy oil), lignite or brown coal to produce district heat, and they have to purchase electricity at fairly high prices. The local industries, too, face a disadvantage against competitors producing in regions already connected to the national gas grid because of the comparatively low – albeit subsidised – prices of natural gas. Also, the local population suffers from high levels of pollution caused by dust, particulates, sulphur oxide and GHG emissions. At the same time, they have to accept high heating energy costs and inconveniences such as the interruption of hot water supplies during the summer months when the cities’ central heating stations are down for maintenance and repair.

This picture applies to many Small and Medium-sized Cities in the Russian Federation.

“Even the longest journey starts with the first step”.

To achieve the long-term goal of connecting all of Russia’s cities to the gas network, a group of experts from OAO Gazprom, its subsidiary OAO Promgaz, the regional gas distribution company OAO Tver’obl’gaz and the German utility E.ON Ruhrgas are working on a pilot project in the city of Kaljasin aimed at optimising local energy supply. Special attention is being paid to the existing heating networks and the central boiler plants, which will be equipped with modern small-scale cogeneration units to produce electricity as well. In addition, there are plans to set up energy advice offices to raise public awareness for energy conservation and urge Russia’s citizens to use gas and other energy sources more sparingly.

The Kaljasin project is already well under way. According to the presentation by the project partners at a conference in Kaljasin on 11 August 2005, preparations – i.e. the construction of the 80 km pipeline connecting the city to the gas grid and the local sub-distribution systems to key industrial and selected housing estates was completed in December 2005. Gazprom, Promgaz and E.ON Ruhrgas will now finalize their business plan on the basis of which realization of the project will start in 2006. The aim of this business plan is to create a profitable project that will attract international investors and serve as model for the whole of the Russian Federation.
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1. INTRODUCTION

Most small to medium-sized cities in the Russian Federation are not yet connected to natural gas networks, which means they have to burn “masut” (heavy fuel oil), lignite or brown coal to produce district heat, and they have to purchase electricity at fairly high prices. The local industries, too, face a disadvantage against competitors in regions already connected to the national gas grid because of the comparatively low – albeit subsidised – prices of natural gas. Also, the local population suffers from high levels of pollution caused by dust, particulates, sulphur oxide and GHG emissions. At the same time, they have to accept high heating costs and inconveniences such as the interruption of hot water supplies during the summer months when the cities’ central heating stations are down for maintenance and repair.

The inherent potential is obvious: Inter-fuel substitution, upgrading energy supply systems and improving end-use energy efficiency.

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To achieve the long-term goal of connecting all of Russia’s cities to the gas grid, a group of experts from OAO Gazprom, its subsidiary OAO Promgaz, the regional gas distribution company OAO Tver’oblgaz and the German utility E.ON Ruhrgas are working on a pilot project in the city of Kaljasin aimed at optimising local energy supply. Special attention is being paid to the existing district heat networks and the central boiler plants, which will be equipped with modern small-scale cogeneration units to also produce electricity. In addition, there are plans to set up energy advice centres to raise public awareness for energy conservation and urge Russia’s citizens to use gas and other energy sources more sparingly.

The Kaljasin project is already well under way. According a presentation by the project partners at a conference in Kaljasin on 11 August 2005, preparations – i.e. the construction of the 80 km pipeline connecting the city to the gas grid and the local sub-distribution systems to key industrial and selected housing estates was completed in December 2005. Gazprom, Promgaz and E.ON Ruhrgas will now finalize their business plan on basis of which realization of the project will start in 2006. The aim of this business plan is to create a profitable project that will attract international investors and serve as model for the whole of the Russian Federation. This initiative has the support of organisations such as the European Business Congress e.V., Berlin, and even the Economic Commission for Europe of the UNITED NATIONS in Geneva.

The process of renewing and modernizing Russia’s local energy structures provides business opportunities to numerous branches of industry and to the banking sector.

The message to be conveyed is that a commitment in this sector will be long-term and profitable, making it worthwhile to take the first step.

2. ENERGY SAVING POTENTIALS IN THE RUSSIAN FEDERATION

The energy saving potential in the Russian Federation is estimated at about 360×10^6 to 430×10^6 standard fuel units (similar to tonnes of coal equivalent - tce) which is approx. 40-50 % of the country’s current energy consumption.

The sectors
- power and heat generation,
- industry,
- residential and commercial users

each account for around one third of this potential.
Given the high share of natural gas in Russian energy supply, energy-efficient natural gas applications play a key role in unlocking the energy saving potential. For natural gas, this potential is estimated at \(122 \times 10^9\) m\(^3\) of natural gas \((141 \times 10^9\) tce\), which corresponds to about one third of total domestic gas consumption in Russia.

The measures available for realising this potential basically include:

- efficiency improvements for gas used as a fuel or feedstock (direct measures), and
- savings in the area of gas-fired heat generation (indirect measures)

3. EXPANDING RUSSIA’S NATURAL GAS GRIDS

Connecting regions in Russia to the natural gas grid is currently one OAO Gazprom’s most important strategic activities. The principles and conditions governing this programme were decided by the Gazprom board of management in 2003. It is aimed at laying the groundwork for economic recovery in the different regions of the Russian Federation by using the low (subsidised) gas prices on the domestic market to increase economic output, raise living standards and improve environmental conditions. OAO Promgaz, a Gazprom subsidiary has been tasked with providing technical and planning support during project implementation.

The gas penetration rate across the whole of the Russian Federation is currently estimated at 50% (around 60% in urban areas and 35% in rural areas). To supply the domestic market, more than 3,500 branch lines totalling more than 40,000 km were tied into the main natural gas trunklines. These branch lines serve some 430,000 km of installed local distribution networks. The total number of houses and apartments connected to a natural gas grid is close to \(29 \times 10^6\).

To realise their objective, Gazprom has made available more than \(11 \times 10^9\) roubles since its board of management decision in 2003. The money was used to build 4,500 km of distribution pipelines connecting more than 542 towns and cities with a population of close to \(2 \times 10^6\) to this low-priced and environmentally friendly source of energy.

Current plans are also focused on increasing the rate at which towns and cities throughout the Russian Federation are connected to the gas grid. For this purpose, Gazprom has earmarked another \(35 \times 10^6\) roubles, three times the amount invested so far. A programme has been set up for the period 2005-2007 to identify the regions to be connected to the natural gas grid by building another 12,000 km of distribution pipelines.

These pipelines will serve about 4,000,000 houses and apartments in urban and rural areas. At the same time, some 20,000 municipal and public buildings such as hospitals, kindergartens, schools, more than 5,000 mostly small, local boiler stations and more than 500 agricultural premises will be converted to natural gas. On average, gas flow through the branch lines tying into the trunklines will roughly double.

The current \(35 \times 10^6\) rouble programme to connect Russian regions to the gas grid affects some \(11 \times 10^6\) people. As a result, gas consumption in Russia is expected to increase by some \(9 \times 10^9\) m\(^3\).

4. MODEL CHARACTER OF KALJASIN PROJECT

Gazprom’s programme to connect new regions to the blue fuel also aims at introducing energy-efficient technologies and promoting energy awareness among the general public, in industry and among commercial customers. One of the objectives is to optimise demand for natural gas from an energy efficiency point of view. To get this project on track in a way that will allow the whole process to move forward independently, OAO Gazprom and E.ON Ruhrgas are using their long-standing ties to develop a model solution for the city of Kaljasin and the surrounding rural area. This model solution is designed such that it can also be applied to other regions without requiring major modifications, thereby demonstrating that it makes economic sense and is also worthwhile from a
corporate point of view to invest in the modernisation of local energy supply structures by using existing technology. So, in essence, this project is a logical supplement to Gazprom's programme of expanding the nation's natural gas grid.

4.1. Kaljasin – a representative case

The town of Kaljasin has been selected for the demonstration project because it is a typical rural town in the Russian Federation. Kaljasin has a population of around 16,000 and is situated on the Volga river in the Tver region, some 200 km northeast of Moscow and again 200 km east of the city of Tver in the centre of the Tver region. The town of Kaljasin is the centre of the Kaljasin district. It covers an area of 1,400 hectares and has a quay for barges travelling on the river Volga, a railway link and various industries.

According to the results of an extensive energy audit, the situation for Kaljasin in terms of energy consumption and energy resources can be summed up as follows:

- Outside the city centre, there are mostly privately owned single and two-storey wood and brick buildings. The city centre features multi-storey residential buildings and mostly single-storey public buildings. In all, there are some 600 residential buildings with a total surface area of 320,000 m². They include some 50 four to five-storey buildings. 72% of the living space of the city’s residential buildings is municipal property, which houses around 75% of the population. The other 25% live in the private houses mentioned above.

- As regards the industrial and commercial customer sector, there are various small and medium-sized companies, most of which are located in one industrial zone. They include food and garment manufacturers, wood-processing companies, shoe factories and metal-working plants. All sources of energy are obtained from outside the district.

- Fuels used for heating purposes include mainly masut (heavy fuel oil), coal and wood. Some companies also use their production wastes (wood chips, flax processing waste). Electrical energy is purchased from a power generator for distribution through the municipality’s own grid. The LPG used in the town is delivered in cylinders. Because of supply problems, LPG consumption has been down for some time.

- The high prices for the primary energies used in Kaljasin are a dominant cost factor for the town’s public enterprises. Compared with the production facilities of competitors in regions supplied with the much cheaper natural gas, this is a significant competitive disadvantage.

- The town’s demand for space heat is met by a central boiler station and 27 small local boiler plants operated by the municipality. [In addition, there are another 22 boiler plants used by industry.] The boiler plants provide heat for around 100 residential buildings. There is no hot water supply. The remaining 500 residential buildings rely on stoves and electrical heating systems for space heating.

In total, the town of Kaljasin consumes some 20,000 standard fuel units annually (which includes all fuel types such as light and heavy fuel oil, coal, wood, diesel, petrol for cars, and electricity). This variable can be more or less compared to tonnes coal equivalents (tce). Electricity consumption stands at approx. 35,000 MWh per year.

Of course this results in significant emissions of dust and particles, sulphur dioxide, nitrogen oxides and carbon monoxide, which is a heavy burden on the environment.

So it is obvious that the introduction of natural gas as a low-pollutant fuel would quickly help bring about a lasting improvement of the environmental situation. Also, consumers’ purses would stand to benefit from this price-capped energy, and commercial and industrial users would receive the opportunity to convert their equipment and production processes to natural gas, thus eliminating a competitive disadvantage.

Changing the consumption behaviour of an entire region cannot be left to chance but has to be fostered deliberately and actively. The strategy therefore includes creating general energy
awareness among the public and industry and supporting key projects with a “lighthouse” effect for the this region's energy industry. It is these two aspects that characterise the underlying strategy of the demonstration project.

4.2. General approach to developing local energy structures

The population in the small towns of Russia’s rural regions earmarked for connection to the national gas grid typically receive their heat energy from central boiler plants.

The stocktaking process for the town of Kaljasin revealed that the local boiler plants use non-automated boilers with a very low efficiency. As the central boiler plant supplying more than 100 buildings (approx. 60 % of the population) runs on heavy fuel oil (masut), overall energy supply is extremely inefficient because this fuel has to undergo extensive processing (preheating) to achieve the required viscosity.

According to an in-depth analysis, the central boiler plant would be the best candidate for a “lighthouse” project. Simply converting this plant to natural gas would already achieve significant economic and environmental benefits.

However, there is much more potential to be unlocked. Adding parallel cogeneration unit to the steam boiler would open up the full spectrum of efficiency benefits. The power generated in parallel to the heat could be fed into the town’s power grid, and this electricity would no longer have to be purchased from outside the district, thereby reducing municipal expenditure. Moreover, cogeneration units operate around the year and can therefore help provide hot water to the public, which would significantly improve living conditions.

According to the economic viability calculations made, the cost of installing a cogeneration system would be recouped within a reasonable period of time, and the system would even generate a certain amount of additional funds for investment into improving the heat distribution system.

As part of the process of bringing natural gas into this region, the modernisation of the central boiler plant, its conversion to natural gas and the cogeneration system retrofit with its economic benefits would have a significant lighthouse effect for the entire region, particularly for the commercial and industrial customers. The project would show that natural gas conversions are not just environmentally friendly but also extremely profitable and therefore worthwhile copying.

Once the Kaljasin district has been connected to the gas grid, natural gas will of course become the fuel of choice after some time. Yet market penetration time will essentially depend on two factors:

- the intensity of the effect achieved by this lighthouse project among the general public, and
- the scope and extent to which energy advice can be provided to private, commercial and industrial customers (particularly key industries) in the district by providing tailor-made advice on efficient gas technologies and how to introduce natural gas into industrial processes.

Both activities will be equally important for achieving swift market penetration. The Kaljasin demonstration project covers both aspects, thus providing a promising perspective.

4.3. Copying the Kaljasin model

The demonstration project is designed to allow the general approach to be also used for other regions to be connected to the gas grid. This means, similar projects in other regions will essentially have to focus on two elements: (1) integration of a cogeneration system into the central boiler plant and (2) development of a competent and pro-active energy consultancy structure.

Although the situation in other regions may differ in terms of energy demand and resources, the present project, will, on average, reflect the basic situation in those regions. Because of its structure, this demonstration project concept can be expected to be easily transferable to other
regions earmarked for connection to the grid as part of the scheme to bring natural gas to rural regions.

For the process of reforming rural energy supply structures across Russia to be successful, it will be crucial to highlight the role cogeneration can play in improving the overall efficiency of central boiler plants and underline the reliability of municipal operators e.g. as borrowers of loans for these projects, in order to create trust among banks, financing institutions and leasing companies for them to cooperate with municipal boiler station operators in the regions to be connected to the grid.

The results of the demonstration project will help to create this trust and promote confidence in these kinds of transactions, thereby removing one of the major obstacles to the modernisation of regional energy structures from within. The project will show that local authorities can be reliable partners capable of paying back their loans from the profits generated by these investments.

4.4. Motivating decision-makers to save energy and helping industry to introduce energy-efficient technologies

Creating energy awareness and a willingness to invest in energy-efficient natural gas-fired systems and a way of promoting rational energy use will be a long-term task. But here, too, it is important to take the first step.

In the demonstration project, this first step is a two-track one. Apart from general awareness campaigns aimed at informing operators of public facilities and industry about natural gas availability in the district and the possibilities of saving energy, there will be more specific consultancy initiatives tailored to the needs of local industry, commerce and the most important municipal facilities.

Key industries and large consumers will be invited to seminars to learn about energy conservation and how efficient technologies can affect the bottom line.

Providing tailor-made energy advice to individual companies and/or production facilities includes making economic viability calculations and proposals on what technology to select for a particular process, and the design and conversion process itself.

4.5. Demonstrating the efficiency of cogeneration system in public generation facilities and the reliability of local administrations as recipients of loans

Apart from the consultancy work described above, the town’s central boiler plant (as one of the larger users of energy) will receive special support in implementing the cogeneration project. This will include general planning and design work, assistance in preparing invitations to tender and analysing bids received, support with contractor selection, and financial advice.

Cogeneration is a standard technology for which there are both Russian and foreign contractors. What is crucial is to find a financing model that will allow the operator to cover the acquisition and operating costs using the profits generated with the new equipment. Economic viability calculations for the central boiler station of the town Kaljasin have confirmed project profitability, the main factor influencing the bottom line being the power generated, which no longer has to be purchased from other power generators. The net profits are even high enough to allow additional investments to be made into improving overall system operation (which includes the rehabilitation of the hot water network, etc.).

In order for the demonstration project to have a snowball effect in other regions, it will be crucial to show that the modernisation of boiler stations can itself be profitable without having to rely on subsidies. Only if the economic parameters are right and the operators of these local stations prove to be reliable investment partners (both of which will be demonstrated by this project) can and will this project be an incentive for investors in other regions.

5. LONG-TERM EFFECTS

The environmental benefits to be gained from expanding natural gas use into new regions are enormous. Dust and particle emissions will drop to almost zero in the long term, sulphur dioxide output
will be reduced by more than 99%, nitrogen oxides by around 30% carbon dioxide by some 25%.
Given these figures, it makes sense to examine whether these extremely environmentally friendly
projects can be part of the Joint Implementation process under the Kyoto Protocol.

Apart from the significant environmental advantages described above, projects such as the
demonstration plant will also gradually improve the economic situation in rural regions across the
Russian Federation. The profits generated by central boiler stations equipped with cogeneration
systems could in part be used to gradually modernise and expand local supply networks. This would
improve living standards and improve infrastructures especially for industry and small commercial
businesses. The demonstration process can therefore be seen as a nucleus for a country-wide
renewal process for energy supply structures in rural regions.

6. CONCLUSIONS

With this project, OAO Gazprom as the owner and operator of more than 400,000 km of gas
distribution pipelines, its subsidiary OAO Promgaz as a specialist in developing regional and local
natural gas distribution systems and E.ON Ruhrgas as a strategic Gazprom partner in promoting
energy conservation and energy efficiency in the Russian Federation are setting new standards.
Instead of the usual approach involving a subsidised pilot project (that is soon forgotten after its
completion, even if successful), the present concept is based on a model capable of being copied in
other regions to be connected to the country’s natural gas grid.

With its programme to take gas into rural regions, for which OAO Gazprom has earmarked
35*10^9 RBL until 2005-2007, the company has paved the way for a kind of snowball effect that will
see similar projects in other regions.

Because of its novel systematic approach and the expected benefits for large parts of Russia’s
national economy, this initiative by OAO Gazprom, its subsidiary OAO Promgaz and E.ON Ruhrgas
AG has achieved wide national and international attention.