DIVERSIFICATION OF NATURAL GAS SUPPLY SOURCES
FOR RUSSIAN REGIONS

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Introduction

At present natural gas supply of Russian consumers is mainly carried out by pipelines. The length of gas mains exceeds 159 ths. km; gas-distribution pipelines – exceeds 680 ths. km.

Regional gas-supply systems form the basis of fuel and energy complex, guarantee social and economy development of the country and regions, ensure its energy security. The Strategy of regional gas supply development make provisions for reliable and stable supply of energy resources to consumers, satisfaction of growing natural gas demand, efficient gas application and use. Natural gas consumption changes drastically living conditions of people in the region, provides for improvement of life quality, community air recovery and labor conditions improvement.

The regions of East Siberia and Far East having high hydrocarbon (HC) resources potential, in practice lack gas supply, and natural gas supply level in these regions reaches only 4.1% (natural gas supply level in Russia – 53%).

Along with gas supply development to the North and East of Russia opportunities to apply pipeline transport are decreasing. It is explained by considerable distance from final consumers to gas supply sources (hydrocarbon fields and gas mains), low density of consumers' location and, consequently, significant capital costs. Eastern territories have difficult land topography (mountains, bald peaks, outcrop of hard rocks, lack of roads, river barriers), complicated conditions of gas pipeline routes passing, severe climate. All mentioned above makes such projects economically unfeasible.

Calculations show that gas supply by pipeline transport become economically unfeasible if the distance between gas consumer and gas supply source exceeds 40-60 km. Considering distances between potential consumers in Siberia and Far East (usually it is hundreds of kilometers) it is obvious that network gas will be supplied only to the settlements located along constructed gas mains.

For this reason gas supply of a majority of Siberia and Far East regions by pipeline transport practically unreal due to high capital costs of construction. These regions include Tuva, Khakass and Buryatia Republics, the Zabaikalye Territory, the Magadan Region. A variety of regions in the Sakha Republic, Karelia, the Krasnoyarsk Territory, the Sakhalin and the Murmansk Regions, and Kuril Islands also belong to this list. It is evident that for the great amount of consumers in these regions it is necessary to use other gas supply sources.

Need of gas supply diversification

The growing demand for energy is fueled by overall economic development of Russia's regions and the national manufacturing sector, and by the need to ensure a comfortable living environment for Russian citizens. Despite the achievements in the field of efficient use of energy resources and energy-savings, market demand for energy in Russia and its regions is expected to grow further. For a majority of Russia's regions, natural gas remains one of the basic types of fuel.

To meet the growing demand for natural gas, it will be necessary to address in the nearest future a complex of tasks related to finding new sources of natural gas supply, expanding the volume of supplies for regional distribution, increasing the efficiency of gas utilization and lowering environmental risks.
Accordingly, the documents substantiating prospective development of gas supply to Russia’s regions and gas distribution for consumers and transport use, view the following components as potential sources of gas supply:

- Supply of pipeline natural gas;
- The use of technology for small-tonnage production and distribution of liquefied natural gas (LNG);
- The use of compressed natural gas (CNG) and adsorbed natural gas (ANG);
- The use of non-conventional sources of gas supply such as coal-bed methane, products of underground coal gasification (UCG), biogas, etc.

The Russian Federation has certain experience in implementing small-tonnage LNG pilot projects for gas supply and distribution to industrial, municipal and domestic consumers in the Leningrad and Sverdlovsk Regions, pilot industrial production of methane from coal beds in the Kemerovo Region, the use of CNG for supply and distribution to municipal-domestic consumers and for transport needs in more than 50 Regions.

Russia possesses the necessary technologies and relevant equipment for applying them in gas supply and distribution investment projects.

Alternative sources of gas supply can be generally used:

- for autonomous gas supply to remote facilities located far away from regular gas-supply sources (the Unified Gas Supply System of Russia);
- for gas supply for inefficient consumers (vis-à-vis the pipeline construction cost), or consumers deemed inefficient from the economic point of view or due to geographic or other nature-related conditions;
- as a provisional measure pending construction of a gas network pipeline (being the technology which is less capital-intensive and the most mobile);
- as a back-up fuel;
- to accommodate peak seasonal loads (in autumn and winter), etc.

Specific gas supply and distribution technology is selected on a case-by-case basis, taking into account the existing economic and geographical conditions in the region, availability of raw materials and efficiency of use of the fuel in question.

**Diversification of gas supply sources**

**Liquefied natural gas (LNG)** is considered as gas supply source. Its small-tonnage production is possible to organize at gas-distribution stations (GDS), on mini-plants constructed at gas pipeline branches or directly on gas fields. Pilot-plant LNG production is already organized in the Leningrad and in the Sverdlovsk Regions.

Potential of LNG production only on operating GDS in Russia (excluding Siberia and Far East) is estimated in 22 bln. m³ annually. Mini-plant LNG production is practically unlimited, depending only on the gas pipeline branch line load. LNG supply from production source to consumer is carried out by motor, railway and sea (river) transport.

In Russia exist inland producers of gas liquefaction, LNG storage and transportation equipment. At the same time they are interested in cooperation with producing companies of other countries, where LNG is applied; normative base and LNG technologies are elaborated, operation experience is available.

Decision on application of LNG and CNG for gas supply and distribution is made considering criteria mentioned below.

First of all, it is the case when gas pipelines construction is unfeasible from the economic point of view or due to geographic or other nature-related conditions.

As a provisional measure pending construction of a gas network pipeline it allows to remove social strain, to prepare consumer for network gas utilization, to ensure fulfillment of gas supply and distribution facilities construction schedules (within the frame of gas supply and distribution programme of RF regions). Also LNG and CNG as a reserve fuel provide for peak loads shaving on gas supply and distribution systems in the autumn-winter period.

Basic results of R&D activities are described below. Over the past period Gazprom promgaz has formed unique database of potential LNG and CNG customers in 68 Russian regions (224 transport companies, about 6 ths. industrial and 89 agricultural enterprises). Its utilization is profitable for a customer and for a gas supplier as well.

Gas supply and distribution schemes of 362 municipal entities were developed, LNG utilization as a back-up fuel of industrial enterprises in 11 Russian regions was proposed. Feasibility analysis, proving economic efficiency of such a projects implementation, was carried out; equipment set was recommended; LNG and CNG supply sources were determined; price policy was formed. Analysis results are shown that costs to organize LNG complexes for gas supply of regions or individual consumers distant from gas mains 2-3-fold lower than for pipeline construction.

Pay-back period of the projects does not exceed 6 years.

Savings of cash assets due to substitution of traditional energy resources are reaching 50% for furnace and diesel fuel and electric power energy, for fuel oil (mazut) and propane-butane (LPG) – 15%.
Liquefied hydrocarbon gas (LHG) is another energy supply source available now and in future. Fully formed in Russia infrastructure of LHG supply and distribution allows to forecast expansion of its application not only for traditional cooking but also for fuelling of boiler houses (especially of small- and medium-scale capacity).

Now in Russia 9 ths. public utilities and more than 2 ths. agricultural facilities are fuelled by liquefied hydrocarbon gas. Annual consumption of liquefied gas is equal to 1.2 mln. t.

Potential of LHG production is growing. Development of Shtokmanovskoye, Kovyktinskoye, Chayandinskoye, Markovskoye and other fields could at least double LHG production.

The most prospective regions for LHG application are Siberia and Far East. If utilization of network gas is impossible or unfeasible, LHG supply is considered as alternative fuel source for such consumers.

At present economical environment extension of LHG use balanced with natural gas use allows to save the latter on internal regional market. Additional source of LHG production could come from associated petroleum gas (APG) recovery. Banning of APG flaring during oil processing will allow to produce about 5 bln. m³ of methane annually and to forward additional volumes of LHG for fuelling and processing.

So, joint consideration of gas supply alternatives proposed by the projects of long-term development of regional gas supply and distribution systems provides for maximal provision of energy resources demand in the Russian regions, allow to minimize required costs for energy supply system development, to decrease investments for construction and renovation of gas transport and distribution facilities.

In the projects of long-term development of gas supply possibilities of adsorbed natural gas (ANG) use for gas supply of residential and industrial consumers, as back-up and emergency fuel, and as gas-motor fuel are elaborated.

Technology of natural gas adsorption in porous carbon-base materials or porous nano-structures will allow to create gas storages practically at any consumer’s accessible for refilling by roads.

At present in RF and CIS countries sufficient amount of results related to natural gas accumulation in micro porous materials are available. Porous materials already created now allow to store in one volume of substance up to 300 volumes of gas.

Activities on development of adsorbents from cheap organic raw materials (fossil solid fuels, various natural and industrial wastes) are under way in the Russian Federation.

Advantages of ANG before the other gas fuels are: low price at comparable distance run (ANG, CNG); absence of substantial capital costs for organizing of transport fuelling stations; possibility to use common (not thick-walled) bottles; possibility to organize fuelling from low-pressure networks; high environmental friendliness.

Biogas production technology is very promising to ensure energy supply of Russian agricultural sector, for internal consumption, especially at the local level for gas supply of single remote consumers. Biogas is used for heat and power energy production. Bio-energy production plants are proposed to apply for independent energy supply of agricultural complexes and their infrastructural facilities.

In Russia all required bio-fuel production technologies (except ones using food resources - grain and oilseeds) are available.

According to forecast assessments annual biogas production potential in Russia is about 75 bln. m³.

For example, biogas production from kettle, hog and chicken organic wastes of 12 agricultural complexes in the Belgorod Region allows to substitute 127 mln. m³ of natural gas per year. This amount is sufficient for power supply of these complexes without using external power networks.

In the Eastern regions of Russia coal production is prevailing. Every region has more or less developed coal industry. Tens of thousand people are working in coal-production facilities. Increasing gas supply to these regions it is necessary to keep expedient balance of gas and coal consumption, and not allow to shut down coal-production enterprises.

In such circumstances coal in considered not only as basic fuel and energy resource, but also as the source of alternative gaseous raw material production – underground coal gasification gas, coal-bed methane.

It is possible to use underground coal gasification gas for heat and power energy production, for production of ecologically clean liquid fuels, such as methanol, dimethyl ether, liquid motor fuel, and some other useful chemical products. Implementing these activities we could form comfortable living environment and exclude expensive transportations of energy resources from the Central Russian regions.

Resources of coal-to-gas production in the Far East are reaching 38 trln. m³. UCG is considered as a possible resource for gas supply to the Khabarovsk Territory and the Primorski Krai, the Sakhalin and the Magadan Regions.

Over 10 years Gazprom promgaz is carried out research activities on exploration and production of coal-bed methane. Results of pilot experimental activities at the test site in the Kemerovo Region proved good prospects of CBM production.
Coal-bed methane production fields are located close to consumers, which allows to reduce costs of gas compression and gas mains construction. It makes coal-bed methane the most prospective non-traditional energy resource in coal-producing regions.

Total reserves of coal-bed methane in Siberia and the Far East territory exceed 10 trln. m³.

At present coal-bed methane resources are considered as gas supply source for the Sakha Republic, the Krasnoyarsk Territory and the Primorski Krai, the Sakhalin and the Magadan Regions.

Conclusions

Developing of General gas supply and distribution schemes for constituent entities of the Russian Federation allowed to from a program of investing in gas supply and distribution based on alternative supply sources, to make technical and economic calculations demonstrating economic efficiency of the proposed gas-supply projects, to recommend suitable domestic and imported equipment, and to shape the pricing policy.

With the gas supply and distribution network nearing completion, given the continuing implementation of large-scale energy-supply projects in Eastern Russia and the Unified Gas Supply System’s technical limitations constraining economic development of the constituent territories, alternative technologies of gas supply and distribution become a very promising solution.

Potentially hundred billion cubic meters of gas can be produced in Russia annually by applying technologies other than conventional development of gas fields.

Presently Gazprom R&D centers implement a number of measures to establish alternative consumer gas supply, including elaboration and enactment of legal inducements to use renewable energy, development of relevant normative and methodological base, information support, development and introduction of unified high-tech equipment, R&D activities.

International cooperation in this field cannot be anything but beneficial.