EFFICIENCY OF GTL INDUSTRY CONSTRUCTION IN JSC “GAZPROM”

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ABSTRACT

However Russian gas industry now faces the new targets. Firstly it is diversification of sales markets and commercial products markets in order to guarantee sales, efficient sales management and improving the general efficiency of the company.

One of the major directions of activities to address this problem is building the industry of synthetic liquid fuels.

This study is devoted to the problem of GTL projects development within GAZPROM system and their efficiency assessment.

In the view of natural gas fields location and various conditions of feed shipment we have considered 12 potential sites located on RF territory. These sites principally cover all types of feed and all options of allocation the GTL plants with capacity from 1 to 30 billion m$^3$ per year.

The study contains technical economic assessments of plants efficiency using own input data on prices, tariffs, rates, railroad shipment and freight, sales volume at the inner and outer markets etc.

As a result of works for some of the site was achieved the necessary IRR. Besides it was stated that the strongest influence on efficiency is produced by investment scope and product price. Therefore improving GTL products efficiency shall mainly aim at reduction of capital investments and growing the share of Russian equipment.
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1. INTRODUCTION

Let me thank you for the opportunity to report at the international gas conference the results of our work relating to the task of building up of the GTL industry in Russia.

In 2003 the Gazprom’s board adopted a decision on the development of a domestic GTL technology and building up of synthetic liquid fuels production. The task to develop a concept of production of GTL at Gazprom’s facilities was assigned to the head scientific center of the national gas industry - VNIIGAZ Ltd.

Two major reasons for development of synthetic liquid fuels production are depletion of oil reserves and toughening ecological requirements to motor fuels.

Only a few years ago there was an opinion that there is no clearness with GTL projects, that a potential production of synthetic liquid fuels should be viewed as a possibility to obtain an ultraclean diesel fuel for motor vehicles operating in major cities. At present a number of new proposals have appeared pertaining to possibilities of GTL technologies application.

2. PREREQUISITES FOR GTL PROJECTS DEVELOPMENT

It concerns the countries having significant stranded gas reserves with fields located at great distances from consumption areas and with complete absence of transportation infrastructure. The use of GTL technologies at a commercial scale will allow gas producing countries and oil and gas companies to turn into a wanted product those large gas reserves which used to be viewed as inefficient to produce and deliver to the consumer.

The second very serious problem is the necessity of reduction of atmospheric emissions of exhaust gases from motor vehicles. As compared to oil fuel, produced from gas synthetic liquid fuels has much better “ecological” characteristics (Fig. 1).

![Figure 1. Decrease of the diesel engine emissions with use of synthetic fuel](image1)

The existing and perspective processes for producing environmentally clean fuels at oil refineries are very expensive. The following table contains a comparative assessment of production costs for environmentally clean fuels produced with use of oil refineries technologies and GTL technologies (Table 1).

<table>
<thead>
<tr>
<th>Table 1. Cost of product unit ($/barrel)</th>
<th>GTL production</th>
<th>Modern oil refinery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost of raw natural gas (with price of 40 $/10^3 m^3)</td>
<td>11.14</td>
<td>40.00</td>
</tr>
<tr>
<td>Price of crude oil</td>
<td>4</td>
<td>2.5</td>
</tr>
<tr>
<td>Operational costs</td>
<td>15.14</td>
<td>42.5</td>
</tr>
<tr>
<td>Return of investments, taxes</td>
<td>12</td>
<td>6.5</td>
</tr>
<tr>
<td>TOTAL:</td>
<td>27.14</td>
<td>49.00</td>
</tr>
</tbody>
</table>
In this table one should pay attention to the cost of raw material. It is evident that when using real prices at markets of West Europe, North America, Japan the economics of GTL plants will not be efficient. Hence, an important conclusion: GTL projects will be profitable only for countries with significant resources of relatively cheap gas, and the most significant reserves of such gas are in Russia and, naturally, in Gazprom.

Beside already mentioned, there are another three very important reasons for Gazprom:
1. Build-up of a less costly system of energy carriers transportation;
2. Efficient utilization of vast resources of low-pressure gas;
3. Diversification of activity and a possibility of entering the world market with ecologically clean fuels.

1. The provision of the Russian Federation with natural gas and further development of gas industry in Russia in the near future is linked with the development of remote, hard-to-reach fields located in the arctic seas and the continental shelf areas. Geophysical surveys proved the further spreading of the natural gas structural reserves into basins of the Arctic Ocean. Development of these fields is impossible without elaboration of commercially attractive scheme of transportation of produced hydrocarbon materials to consumers in CIS and West Europe. The creation of a gas pipeline system for transportation in these areas is very expensive because of large distances and severe climate. The construction of a single line connecting the Yamal peninsula with Europe (over 3500 km) will cost about 10 billion dollars.

In addition, the cost of natural gas increases during its transportation by 13-15 $/10^3 m^3$ every 1000 km (construction of booster stations, transport etc.). With gas production at shelf these costs will be even higher. Apart from construction of long-distance pipelines and liquefying natural gas with the following its transportation in special tankers, a possible decision of the task is chemical processing of natural gas into mixture of liquid hydrocarbons, including motor fuels, right in production areas, with the following transportation by a more economically efficient transportation system (tankers, minor-diameter pipelines, railroad).

2. Our institute has carried out an assessment of potential volume of low-pressure gas fields production in Western Siberia, with a wellhead pressure up to 2.0 MPa.

The figures are very big: only for two field (Urengoi and North Urengoi fields) a potential volume of low-pressure gas amounts to 650.6 billion m$^3$. Dynamics of volume of low-pressure gas production is also impressive: by 2010 – 11 billion m$^3$, and by 2030 – 20.6 billion m$^3$.

The figure 2 shows annual low-pressure gas production of Gazprom’s fields (Cenomanian) in Western Siberia for the period 2010 to 2030.

![Figure 2. Expected volumes of low-pressure gas production (Cenomanian) on the fields of Western Siberian](image)

3. By 2020 the world oil and oil products consumption, according to different estimations, will increase by 1.2-1.5 times (most probably – by one third).
The growth of demand for oil in Europe in the period to 2020 will be determined, in the main, by the necessity of replacing oil from the North Sea and will account for about 180-200 million ton/year as compared with the year 1995. In the same period the increment of demand for oil in Asia will be driven by the growing consumption of oil products and will account for about 820-850 million ton/year.

On the whole, the perspective world energy situation allows to forecast at least the same, or most likely, increased level of export demand for Russian energy resources, with a view to Russia’s entering energy markets of Asian-Pacific region.

The volume of demand for Russian energy carriers will be limited only by their competitive ability.

The Russia’s energy strategy envisages keeping up significant volumes of energy resources export, natural gas and liquid fuel in particular, with priority growth of the oil products pickup and delivery. However, the growth of their supply to foreign market is expected to cease already by 2012-2015. Moreover, the Russia’s share in international oil and oil products trade will decrease from the present day 9% to 4-5% by the end of the considered period.

In the opinion of authors of ES-2020, in the second half of the forecasted period (2010-2020) Russia may enter the world LNG market at large scale and start exporting synthetic motor fuel.

According to the largest consulting companies, in the nearest 10-15 years the GTL production will reach a level of 95 million ton/year or 4% of the world production of motor fuels.

According to forecasts for the period 2010-2020, the demand of European markets for gasolines will stabilize practically at the present level (or insignificantly increase); and the consumption of middle distillates will increase by more than one third. As a result, by 2020 a demand of Western Europe for diesel and gas oil amount to more than 350 million ton/year (Fig. 3).

It should be stressed the market for the GTL plants final products is practically unlimited, with prices of motor fuels being continuously increased. At that, the development of GTL projects is not competing with the oil refinery industry. On the contrary, the production of quality components of motor fuels at GTL units will allow the oil refinery industry to solve the problem of enhancing the quality of supplied fuels.

In 2005 Russia supplied for export about 27 million ton of diesel and gas oil. Keeping up the level of diesel export and a certain increase are planned for the future. However, due to the low quality, the prices of the domestic diesel are much lower than that of the world market. In addition, in order to meet the requirements of future standards the national industry may need 5-7 million ton/year of a high-quality component of diesel fuel.

Of course, we cannot ignore the domestic oil refinery industry also trying to enhance the quality of its products. But with a view to the above said, a real possibility opens before us, i.e. Gazprom, of diversification of our activity – additional realization of products equivalent to approximately 50-55 billion m$^3$/year of natural gas. This is a gigantic volume of gas, which already now should be reserved for GTL plants.
From the above said follows that the interest of Gazprom lies not in the construction of a GTL plant at some of its sites, but in creation of the GTL industry (products of the Fisher-Tropsch synthesis and DME) with a significant number of plants. This will allow to solve the task of development of economically “hard” fields and organize large-scale production of highly efficient products which in recent years will have a stable and reliable demand on the world market.

3. TENTATIVE INVESTMENT ANALYSIS RELATING TO THE TASK OF BUILDING UP THE INDUSTRY OF SYNTHETIC LIQUID FUELS IN GAZPROM’S SYSTEM

In 2004 we fulfilled a work, which is called “Tentative investment analysis relating to the task of building up the industry of synthetic liquid fuels in Gazprom’s system”.

The goal of this work was a technical and economic assessment of feasibility of the GTL plants construction and determination of the most attractive projects for preparation of substantiation of investments into construction of pioneering GTL plants.

We have selected 12 sites, which in principle represent all types of feedstock and practically all variants of plants location:

- geography of plans’ location (Fig. 4),

- characteristic of GTL plants: developed areas, Nadym-Pur-Taz, Yamal, shelf, remote fields, offshore terminals regions (Table 2).

![Figure 4. Industrial sites for building up GTL plants](image)

Table 2. Sites considered for constructing GTL plants

<table>
<thead>
<tr>
<th>Type of raw material</th>
<th>Location of GTL plant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low-pressure natural gas (pressure of the well exit &lt; 2.0 MPa)</td>
<td>Nadymgazprom, Medvezhie field</td>
</tr>
<tr>
<td>Tank natural gas (Gazprom’s facilities having the necessary infrastructure)</td>
<td>Orenburggazprom, Vostokgazprom (Tomsk petrochemical complex), Astrakhanagazprom, Severgazprom, Yamburggazdobycha</td>
</tr>
<tr>
<td>Trunk gas</td>
<td>Primorsk</td>
</tr>
<tr>
<td>Marginal field</td>
<td>Kubangazprom</td>
</tr>
<tr>
<td>Remote fields</td>
<td>Vostokgazprom (Ust-Kut), Yamal peninsula, Kharasaveiskoye field</td>
</tr>
<tr>
<td>Shelf gas</td>
<td>Shtokman field</td>
</tr>
<tr>
<td>Associated petroleum gas</td>
<td>Yuzhno-Balyksky gas processing complex</td>
</tr>
</tbody>
</table>
The plants’ capacity was determined taking account of the site’s potential so that in the end there was a full field of values, i.e. small, medium and large plants (Table 3).

### Table 3. GTL plants capacity

<table>
<thead>
<tr>
<th>GTL plant location</th>
<th>Plant capacity by natural gas, $10^9$ m$^3$/year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nadymgazprom, Medvezhie field</td>
<td>3.0</td>
</tr>
<tr>
<td>Orenburggazprom</td>
<td>9.0</td>
</tr>
<tr>
<td>Vostokgazprom (Tomsk petrochemical complex)</td>
<td>1.0</td>
</tr>
<tr>
<td>Astrakhangazprom</td>
<td>6.0</td>
</tr>
<tr>
<td>Severgazprom</td>
<td>3.0</td>
</tr>
<tr>
<td>Yamburggazdobycha</td>
<td>24.0</td>
</tr>
<tr>
<td>Primorsk</td>
<td>24.0</td>
</tr>
<tr>
<td>Kubangazprom</td>
<td>0.8</td>
</tr>
<tr>
<td>Vostokgazprom (Ust-Kut)</td>
<td>24.0</td>
</tr>
<tr>
<td>Yamal peninsula, Kharasaveiskoye field</td>
<td>24.0</td>
</tr>
<tr>
<td>Shtokman field</td>
<td>24.0</td>
</tr>
<tr>
<td>Yuzhno-Balyksky gas processing complex</td>
<td>0.7</td>
</tr>
</tbody>
</table>

Such assumption is justified because the capacity of one technological line of modern GTL plants is at a level of 1.0–1.5 billion m$^3$ of feedstock or 0.65 to 1 million ton of synthetic liquid fuels, and in the first approximation one can speak about gradual increase of the number of technological lines.

The volume of initial data for every site is as follows (Table 4).

### Table 4. Initial data for GTL projects evaluation

- GTL plant location
- Basic information on the site (climatic and geographic characteristic, railroads, ports, availability of auxiliary resources etc.)
- Characteristics of natural gas (volume, composition, pressure, temperature etc.)
- Existing infrastructure and a possibility of integration with operating facilities
- Perspective price for natural gas
- Volume of local markets of GTL products and perspective prices
- Additional data for economic calculations (cost coefficients, taxation, duties, excises etc.)

A few words on the products marketing.

As of today, not a single company in the world has reliable data on GTL products marketing, all studies are of probabilistic character. The world consulting agencies expect the volume of synthetic liquid fuels at a level of 75-95 million ton/year. Our analysis of existing world projects shows that by 2010 synthetic liquid fuels supplies to the world market will amount to about 15 million ton/year.

The basic product of GTL plants (about 70%) is diesel, which we distributed as follows: Russian market – 30-35% and the world market – 65-70%.

In the world market there is a reliable correlation of prices for oil and oil products. In this work we calculated the world market prices for products proceeding from the price for oil - $40/barrel.

Using this approach we received the following prices: $392/t for diesel and $368/t for naphtha. An extra charge ($10/t) for the synthetic diesel quality, equal to that of Euro-5 fuel was assumed according to data of the “Purvin & Gertz” company.

We have carried out our calculation using our own initial data on prices, tariffs, rates, costs of railroad transportation and freight, volumes of products realization at internal and external markets etc. We took into account the existing state of affairs at already developed site and construction underway, in some cases started from scratch.
4. CONCLUSIONS

For some sites we managed to achieve rather decent results, i.e. when IRR is no less than 15%. Naturally, the most efficient sites are the sites of our operating facilities where the volume of capital investments can be decreased due to the use of existing infrastructure.

In our opinion, three stages are relevant for Gazprom in building up of the GTL industry:

- 1 stage – “fast” small (0.5-1 billion m³/year of gas) projects which should demonstrate the efficiency of obtaining synthetic liquid fuels, profitability of used technologies, and supply to market the first batches of synthetic fuels. These plants will be also used to train engineers and technologists for all new plants.
- 2 stage – medium-term projects – commercial projects of medium capacity (3-5 billion m³/year of gas) which could solve regional problems with ecologically clean fuels and problems of entering the world market.
- 3 stage – large-scale projects (10-30 billion m³/year of gas) at field of Yamal, Eastern Siberia, the Arctic shelf etc.
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