Conditions and Prospects for Development of Petrochemical & Gas-Derived Chemicals Industry in the Russian Federation

Research Report

SYNOPSIS

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CONTENTS

LIST OF BASIC ABBREVIATIONS

GTL – Gas To Liquids (this term means gas-derived chemicals-related technologies for direct conversion of gas into liquid products); in Russian, the term gas-to-liquid technologies (GZhT is also used);

MTH – Methanol To Hydrogen (a gas-derived chemicals-related technology for producing hydrogen from methanol);

MTO – Methanol to Olefins (a gas-derived chemicals-related technology for producing olefins from methanol);

LNGFS – LNG/LPG filling station for motor vehicles;

GD – gas distillate (natural gas having high content of higher hydrocarbons – ethane C_2, propane C_3, butanes C_4, C_{5+} petroleum fractions);

VIOGC – vertically integrated oil and gas company;

GFP – LNG/LPG filling point;

GFS – LNG/LPG filling station;

GRP – gas refining plant;

GRIP – gas refining integrated plant;

GTS – gas transportation system;

GDCIP – gas-derived chemicals integrated plant;

PPP – public-private partnership;

DME – dimethyl ether;

CB – chipboard;

UGSS – Unified Gas Supply System;

HUS – housing and utilities sector;

CS – compressor station;

AFC – amino-formaldehyde concentrate (a product produced by condensation polymerization of formalin and urea (these are derivative products produced by gas-derived chemicals sector from methanol and ammonia), it is widely used in the process of production of such materials as cellular plastic, chip boards and fibre boards, plywood, flowing agents, inhibitors, etc.);

LLDPE – linear low density polyethylene (a thermoplastic produced from oil; it is used for making plastic bags with die cut handles or loop-shaped handles);

MFFS – multifuel filling station;

MDF – Medium Density Fibreboard;

SMB – small and medium-sized businesses;

MTBE – methyl tertiary butyl ether (a product synthesized from isobutylene and methanol; it is used as a motor fuel additive increasing gasoline octane number (an antiknock agent));

UGC – unstable gas condensate (gas condensate having significant content of methane & butane fractions; upon removal of a substantial portion of such fractions, the condensate is transformed into a stable one);

PCGDCII – petrochemical & gas-derived chemicals industry;

OR – oil refinery;

PVC – polyvinyl chloride (a white plastic being a thermoplastic polymer of vinyl chloride; it is widely used, for instance, for producing electric insulation of wires and cables, pipes, furniture, window profiles, etc.);

APG – associated petroleum gas;

PP – polypropylene (a white powder; it is used for producing films (especially, film packaging materials), bags, containers, pipes, parts of technical equipment, householdware, nonwoven fabrics, etc.);

HDPE – high density polyethylene (white wax-like mass; it is used for producing transparent packaging bags, as well as bags having die cut handles or loop-shaped handles and garbage bags);

LDPE – low density polyethylene (it is used for producing undershirt-shaped bags and transparent packaging bags);
MPP – mobile power plant;
PET – polyethylene terephthalate (a thermoplastic, being the most widely used material of polyester class being used, among other things, for producing standard plastic bottles);
SNG – stable natural gasoline (a product similar to straight-run gasoline (in the oil refining sphere));
SGC – stable gas condensate – a liquid product containing limited shares of light fractions (C_{1-4}), therefore, being suitable for transportation in standard rail tank cars or by motor transport;
DSG – dry stripped gas (a gas refining product composed mostly of methane, with the addition of ethane and, in quantities permitted for transportation via pipelines, heavier fractions);
LPG – liquefied petroleum gas (composed mostly of a mixture of propane and butanes; it can be transported in specially designed tanks);
CGFP – central gas fractionation plant;
NGL – natural gas liquids (a primary gas processing product composed of various higher hydrocarbons; its specific composition may vary considerably depending on composition of the original gas and processing method);
ETBE – ethyl tertiary butyl ether (a colourless, transparent, fluent, highly flammable liquid having an etheric odour; it is used as an additive agent in the process of producing gasoline from crude oil).

1. INTRODUCTION

With the entire range of problems related to in-depth modernization of the Russian economy and boosting up its innovation drive still in the center of discussion, these problems are evidently nearing their comprehensive solution focused on the attaining of relevant goals.

It seems of utmost importance to correctly set the priorities of the new policy and select the policy strands which are most likely to lead our country to efficient and prompt buildup of its retrofitting potentialities.

This survey is designed to find out and demonstrate the anticipated potential mights of the oil and gas refining as well as oil- and gas-derived chemicals sectors with a view to a full-scale yield of widely ranging end products.

In the state-planned economy of the now deceased Soviet Union these spheres were either unduly disregarded, or gravely misrepresented due to a number of reasons. First and foremost, the top priority of the Soviet-era economy was given to the needs of the military establishment, followed by gaining maximum export revenues. The situation was aggravated by lack of investment resources, especially their hard currency component, as well as the absence of room for positive economic diversification and development of entrepreneurship.

Furthermore, solutions were sought for in those times based on the contemporary resources and technologies. Oil resources were the basis for the whole refining sector and, given the general economic priorities and opportunities available, overall production growth was primarily achieved by increasing output of low octane motor fuels (for defence-designated transport and civil sector automobiles with low requirements to fuel quality) and feedstock for petrochemical industry produced at earlier phases of oil refining, with inevitable, in this case, high volumes of black oil fuel production. Initially, the black oil fuel was used on a large scale at electric power plants and further on, as the significance of natural gas increased, it started to be used, basically, as a reserve fuel and be exported actively. In the post-Soviet period, such decisions which were justified in some way at the time of their adoption, became a serious factor restricting the development and modernization of the entire refining sector.

A great problem, as it has always been in the Soviet times with the issues not falling within the scope of responsibility of any agency, was utilization of associated petroleum gas (APG) resources: these resources turned out to be at an intersection of spheres of influence of the then Ministry for Oil Industry (in charge of, among other things, development of oil fields, in the course of which the APG was produced) and the then Ministry for Gas Industry (plans of which were aimed at production and supply of, primarily, natural gas). As a result, these resources were abeyant for a long time, until the government program for using these resources was launched. Unfortunately, first an accident involving an explosion at the trunk product pipeline Western Siberia

– Ufa, and then, a grave economic crisis of late 1980s made it impossible to bring these works to a finished state.

Another peculiarity is associated with using recourses of so called ‘fat’ or rich in higher hydrocarbons natural gas (i.e. natural gas rich in ethane, propane, butane and more heavy oil type fractions). It should be noted that at the fields where such gases were produced in the 1960s-1980s (in Krasnodar Krai, at Vuktyl in the Republic of Komi), by virtue of the principle “let us implement our work plan at all costs” (and the plan stipulated the volumes of gas to be produced and supplied, without accounting for sideline products which were gas processing products), such technical solutions were implemented that the bulk of these resources was lost virtually irretrievably.

As a rule, gas was processed at those fields only where the processing was an operational need due to high content of harmful components (hydrogen disulphide and carbon dioxide gas).

In general, such situation stemmed from the fact that the bulk of natural gas was produced at unique Western Siberia fields, notably, from their upper - Senomansky - horizons where gas almost completely consisted of methane.

As a result, just some 10% or 11% of the produced gas was subjected to processing. It came into sharp contradiction with the global practice of developed gas-producing countries: e.g., over 78% of gas is subjected to processing in the USA, and virtually all the produced gas – in Canada. It were such gas refining volumes which made it possible to set up highly efficient and powerful chemical sectors of the economy in these countries. Consolidation of oil and gas producing, oil and gas refining, and petrochemical and gas-derived chemicals enterprises has lead to establishing the largest centres for production of petrochemical products and gas-derived chemicals (petrochemical and gas-derived chemicals industry clusters) in the US Texas and Louisiana. It is right here that 263 out of 579 American gas refining plants and 46% of gas refining capacities of the USA are located.

In recent years, powerful gas refining facilities have been built in many developing countries as well, for example, in the Persian Gulf countries. The volume of gas refining is continually growing in the world, and it reached about 1.6 bcm of processed gas and over 400 million tons of products in 2009. For example, OPEC believes that in the long term, the bulk of growth of the world’s oil consumption would be associated with the increase of output of gas refining products in the form of so called “gas liquids”.

In 1990s, Russia’s entire refining sector passed through a period of extreme adversity: former product consumers sharply reduced their demand for the products, former production and products chains broke down due to “targeted” privatization, links with the former USSR Republics were lost (during the previous period, research centres and pilot plants were located quite frequently in the central regions, for example, in science campuses located near Moscow, while the related major production facilities – in other Republics). As a result of the foreign trade liberalization, the

system of external economic relations has changed, and Russian companies being beginners in international relationships got exposed to global players on the market. As a result, imported product inflow increased, while certain time was needed to develop Russian product export, and it was arranged only for the products having relevant niches on the market. In general, total primitivization of the Russian economy structure affected in the most serious way such a complicated sphere as the refining and processing complex.

Currently, critical time is coming in respect of a whole number of issues and, in our opinion, unique opportunities and challenges are emerging relating to the interaction of fuel & energy sectors and facilities/processes (the chemical complex) for final conversion of feedstock into consumer products.

In particular, it should be noted that within the fairly near term, Russian oil and gas industries, as it follows from the General Schemes for their development prepared in 2010, would transfer to the development of more and more complicated resources. It would require introduction of a more diversified taxation system, under which gradual increase of the share of so called 'difficult' resources would result in the reduction of tax proceeds per product unit. This is especially typical for the oil industry objectively entering its maturity stage and facing the stabilization of its production volumes, but, step by step, it will also become characteristic of the gas sector that will place high-cost resources of Yamal Peninsula, Eastern Siberia, Far East and the shelf, on stream.

So, one could hardly anticipate further significant progress in country's GDP growth, as well as the increase in tax proceeds, on the basis of production of basic products of the oil and gas sector (if not to rely on considerable growth of prices for oil and gas on the global market, which, as years of the crisis showed, would be risky).

The development of the oil and gas refining, petrochemical and gas-derived chemicals industry and, finally, the production, on this basis, of a wide range of chemical products should be viewed as the most important source of not only compensation for potential decrease of revenues from the raw materials sector, but also as the strongest driver of overall economic growth. The tax flow generated by end products would fully compensate for (or, may be, exceed) tax proceeds in the form of export duties for raw material-related products. In addition, the end products have, due to the processing, much higher added value, which is a key source of income.

2. EMERGING STRUCTURE OF PETROLEUM AND GAS REFINING SECTORS AND PETROCHEMICAL & GAS-DERIVED CHEMICALS INDUSTRY DEVELOPING IN RUSSIA

In this Section, a picture of a complicated combination of sectors is presented, part of the segments of which has already been formed, another part is yet emerging in the situation of tougher requirements to product quality, and quite a number of them would be needed to be formed in order that the set of the sectors should take a form of a modern highly productive industrial complex being always open to modernization and innovation processes.

This structure is ultimately based on existing key product lines that are focused on product consumers and secure economic feasibility of the development of relevant production facilities. Products' added value increases with the increase of their process stage number. Actually, a product line would be interrupted either by delivery of a product to an end user, or by export of a certain raw material. Currently, the second option is implemented in the RF more often. The purpose of setting up a general scheme of the RF complex for refining of oil and gas resources and petrochemical and gas-derived chemicals industry ("CROGRPGDCI") and review of potential product ranges is to study a possibility for extending completed product chains from raw materials extraction to production of the products that will be used by end consumers.

First, let's address matters related to components of the modern CROGRPGDCI and what elements of it are already available in the RF.

Within the Russian CROGRPGDCI, apart from its well-developed **production** sector (which is being considered herein in the form of a resource, and its structure is beyond the scope of this research), there also exist fairly well-outlined sectors of **oil refining** and **gas processing**; the latter is currently represented, on the most part, by associated petroleum gas (AGP) processing and processing of gases with harmful admixtures (Gazprom OJSC). When developing oil and gas fields and oil and gas condensate fields, an unstable gas condensate (UGC) was also produced which, after stabilization, could be shipped for further use. In this country, oil refining was largely based on the initial processing phases and production of straight-run products, including straight-run gasoline. The basis for these sectors was laid down as early as in the Soviet times.

During that period, the petrochemical sector was also set up, predominantly focused on the needs of the centrally planned and highly militarized economy.

In addition, refined products (the most important of which is straight-run gasoline or naphtha) are traditionally used in the Russian **petrochemical** industry as key feedstock components for the production of its products. Products extracted from gas in the course of its processing (primarily, stable gas condensate, liquefied petroleum gases (LPG) in the form of various end products, as well as ethane) have been playing recently and would play in the long term greater and

greater part as feedstock for the petrochemical industry. The reasons for that are both low efficiency of simple oil refining with high output of straight-run gasoline and black oil fuel, and growing gas products resources, a process stage chain of which has in many processes economic advantages over the traditional chain originating from oil.

Since the primary feedstock for gas processing are currently associated petroleum gases and UGC, the expansion of APG and NGC use, together with resolving ecological and efficient economy issues in general, is also a pre-requisite for proper operation of many oil and gas companies.

The new situation may be designated as transformation of traditional **petrochemical industry** into a complex industry that may be conditionally designated (to demonstrate changes occurring therein) as the '**PCGDCI industry**' (an abbreviation of more conventional term 'petrochemical and gas-derived chemicals industry'), that is, the production of traditional 'petrochemical products' by means of using both oil refining and gas processing products as a raw feedstock.

Moreover, the oil refining sector, in addition to the production of its major end products (for example, gasolines, kerosenes, diesel fuel), provides also the basic feedstock for the petrochemical industry complex. On its part, gas processing products serve both as consumer products (for example, motor fuel or fuel for daily living needs) and as raw materials for the two following types of processes: PCGDCI industry processes where they compete with oil refining products, and specific processes of **gas-derived chemicals industry** (serving as a specialized sector), where the gas processing products only may be used efficiently.

Petrochemical industry products themselves frequently serve both as a feedstock for chemical enterprises and intermediate products for the production of end products within petrochemical enterprises. Notably, that this range of products suggests that PCGDCI industry has gone beyond academic notions and, together with the gas-derived chemicals industry, comprise the bulk of the chemical industry.

Thus, a distinctive feature of the set of sectors of the economy being considered herein is the production of a great number of chemical substances and products by means of multi-stage processing of the following two basic types of raw feedstock: oil and natural gas.

In Fig.1, the forming CROGRPGDCI structure is shown schematically, and certain product lines are outlined. Both the diagram and the outline of the product lines are presented here as an illustration in order to demonstrate the nature of the processes taking place, and they may in some details differ from the ones frequently used in the literature.

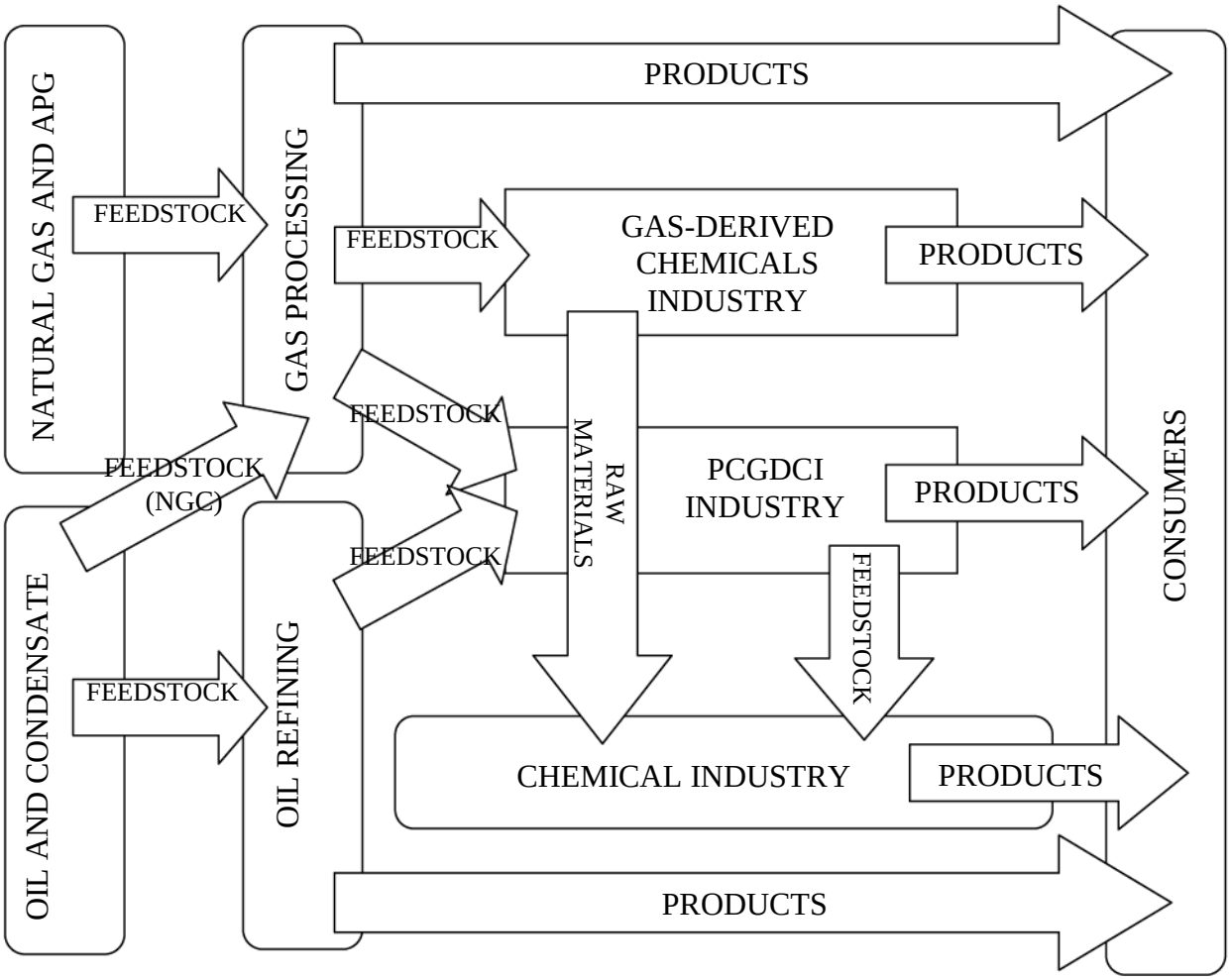

Fig. 1 Emerging Structure of the CROGRPGDCI Sectors

Let's consider potential product lines related to production facility groups outlined on the diagram shown in Fig.1.

Firstly, let us show the gas processing schematically, see Fig. 2.

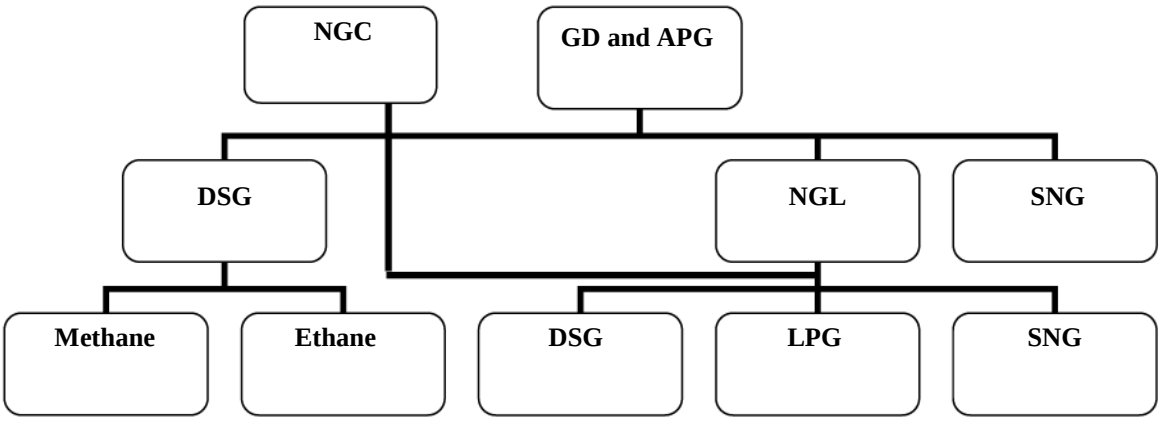

Fig.2 Basic Products with Breakdown by Gas Processing Subsector

Due to a wide variety of products and actual range of oil refining and petrochemical production facilities, just the major product lines of the sectors are outlined below on Fig.1 scheme. It should be noted that each sector shown on the scheme, includes a set of specialized subsectors being different by their feedstock and designation of produced products.

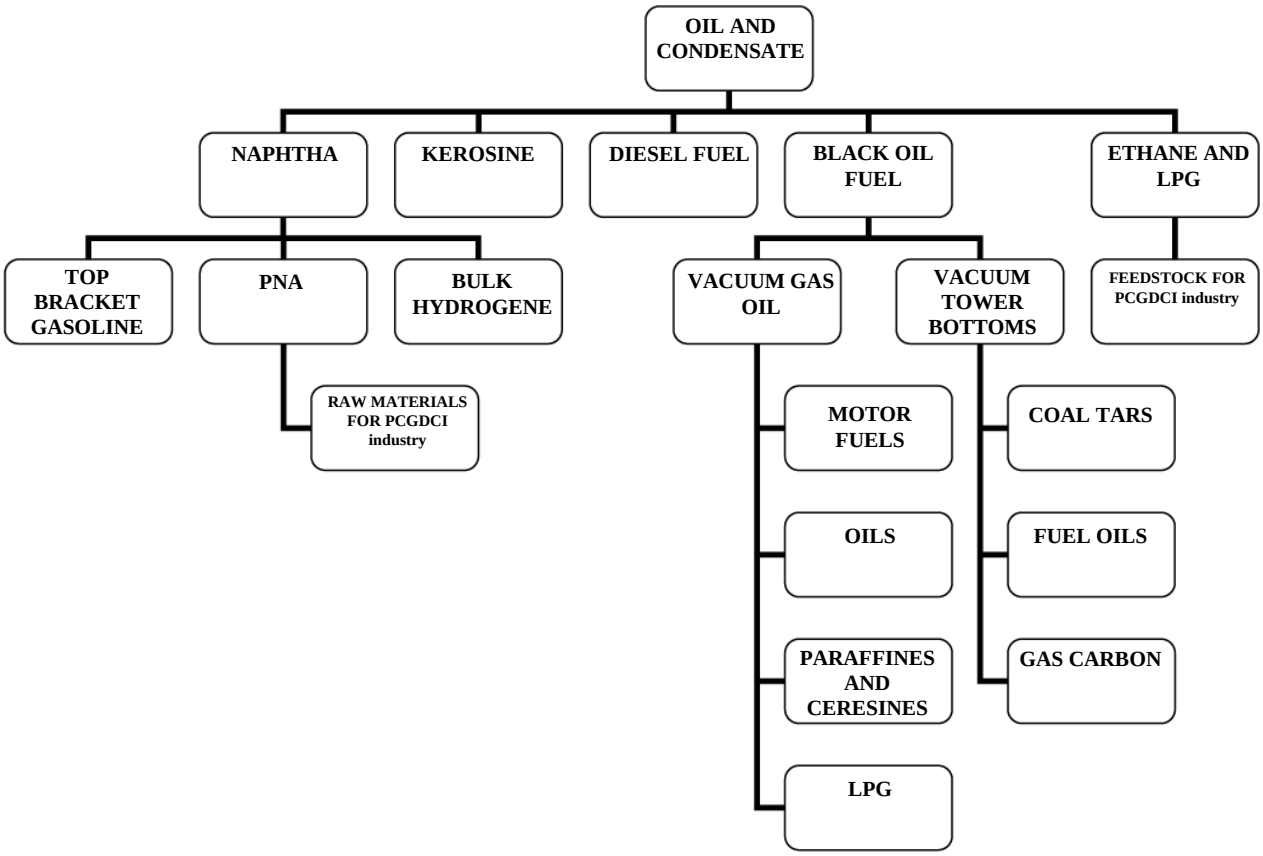

Fig. 3 Major Products with Breakdown by Oil Refining Subsector

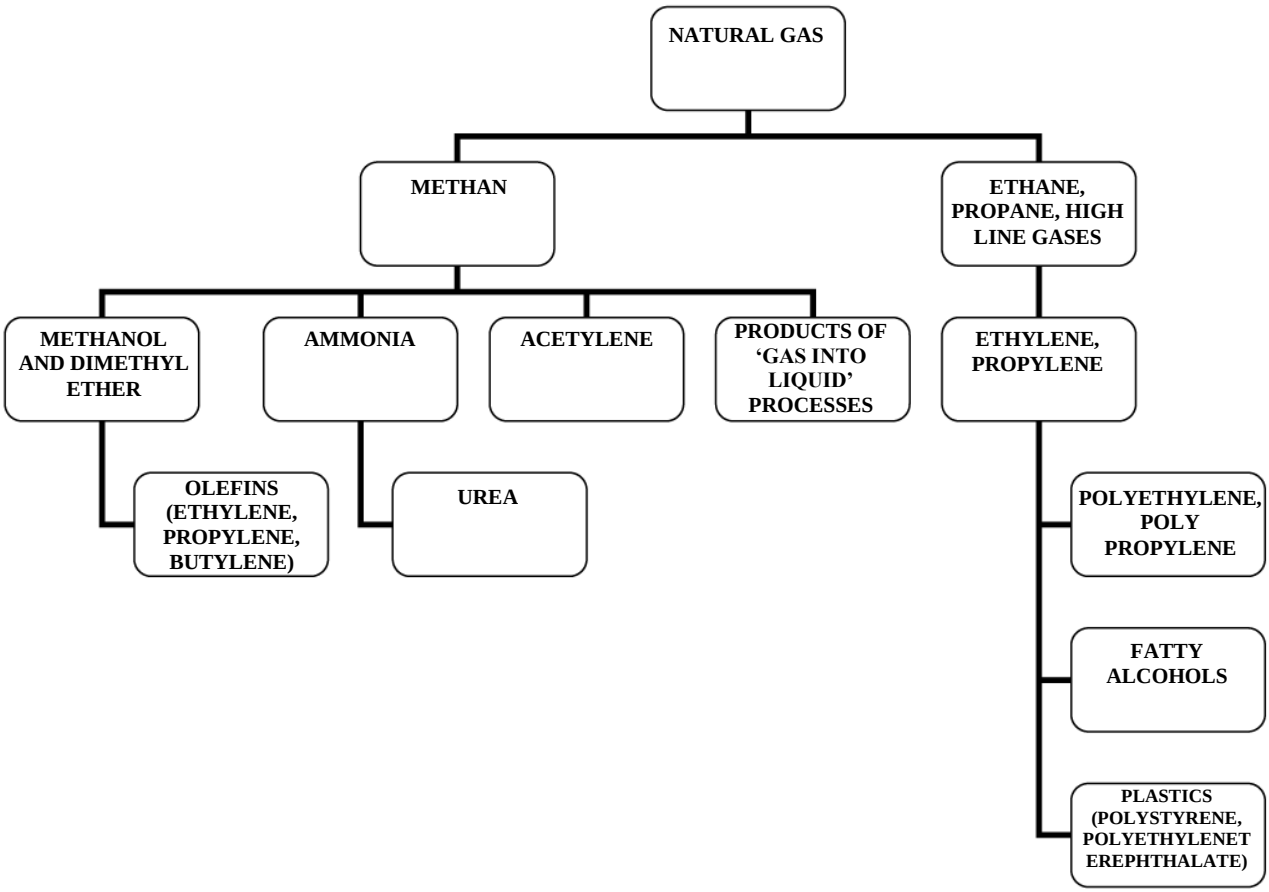

Fig. 4 Major products with Breakdown by Specialized Gas-Derived Chemicals Industry Subsector

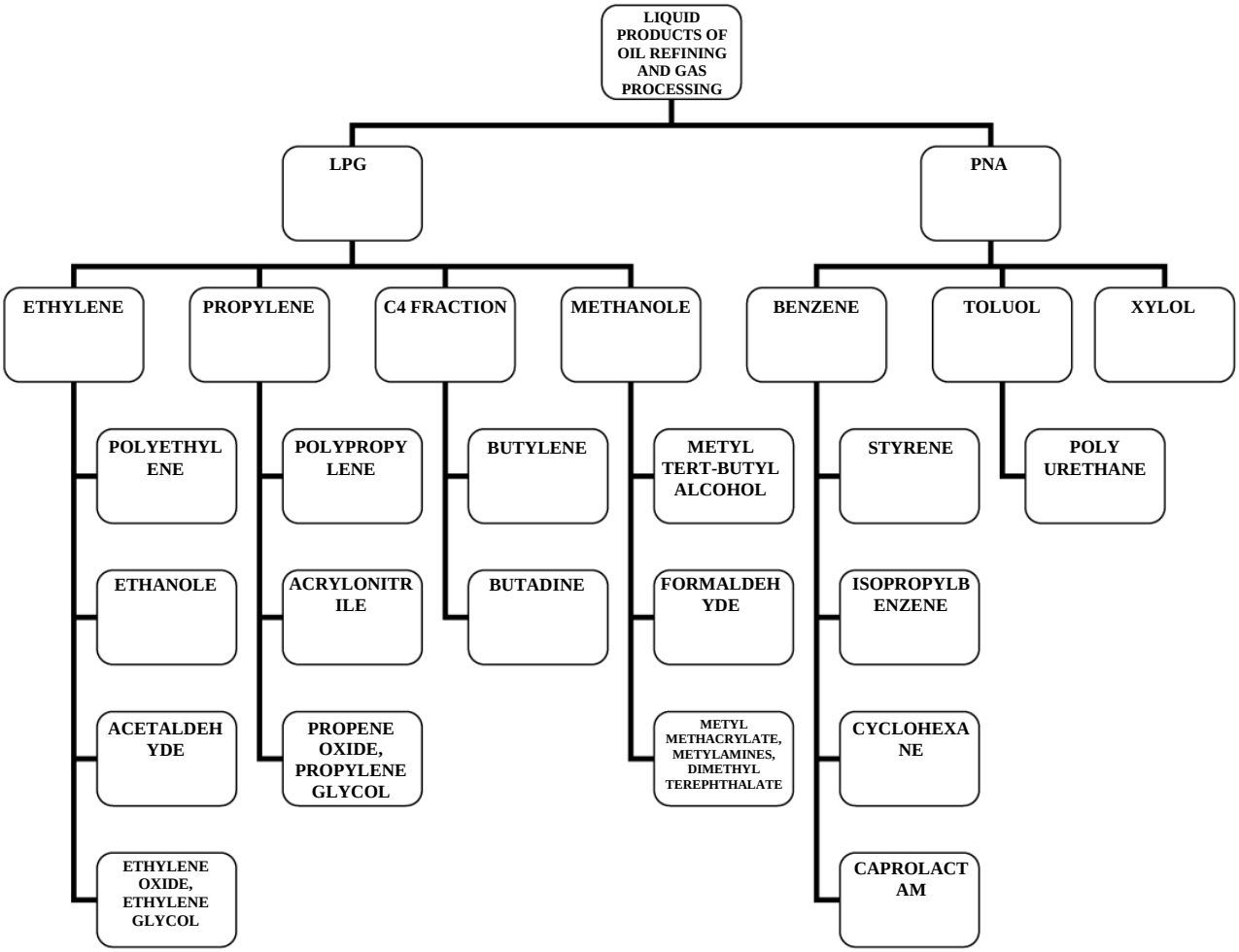

Fig. 5 Certain Major Products with Breakdown by PCGDCI Industry Subsector

PCGDCI Industry products are consumed virtually by all industry sectors and used in the life of all groups of the population. It would be impossible to improve environmental conditions and resolve such global issues as insufficiency of resources, energy and food without developing the chemical industry.

Key sectors consuming chemical industry products are: consumer goods (domestic consumption), intra-complex consumption, machine-building, construction, agriculture, transport, communications, etc.

The dynamics of consumption of chemical and petrochemical products on the Russian market demonstrates more than favourable prospects for growth of the domestic demand for products of the sector on the part of the industrial production sector, agriculture, transport and other sectors consuming sector's products. In particular, it should be noted that, in general, over half of the sales turnover of petrochemical and chemical products takes place within the very chemical complex itself. Domestic consumption in respect of certain groups of products exceeds 90% (polyethylene, polypropylene, polystyrene, polyethylene terephthalate, synthetic rubbers). In

addition, significant, sometimes dozen times increase of the produced products value would be achieved.

The construction and housing & utilities sectors where many goods made of polymer materials, fibre glasses, foam plastics, binding materials, paints, varnishes and lacquers and other chemical products are used, are soaring. The construction industry turned out to be severely affected by the crisis (and the reasons for that are immature structure of production and consumption of its products, formed during the period before the crisis), however, it is obvious that country's social & economic needs require a long-term and significant growth of this sector.

In the machine-building industry (machine-tool building, auto-, aero-, shipbuilding industry, etc.), there grows the demand for parts made of structural polymer materials, special paints and coatings, sealing, noise-absorbing materials and many other products, the use of which materially facilitates the production technology in these sectors, makes it possible to improve quality of the products produced by them, and in many cases it is still impossible to replace such products with any substitutes thereof.

In order to rehabilitate the domestic consumer goods industry, boost the production of auto and special tires, it would be needed to development further the production of chemical fibres and man-made yarns.

Ensuring the defence and security and economic independence of the country would be impossible without the development of production of the domestic chemical and petrochemical products, since there is no alternative to their use in many military-oriented products.

Given the changes in macro-economic indices and the strategies and prospects for the development of related branches and sectors of the economy, a significant growth of market capacity is predicted.

In Russia, unit production and consumption of chemical and petrochemical products per capita lags behind compared with the developed countries substantially. In 2005, per capita consumption of plastic materials and resins with breakdown by country was as follows (kg/person):

- Russia – 25.9; USA – 276.4; EU – 200, on an average; Japan – 104.5.

Chemical fibres and man-made yarns:

- Russia – 1.1; USA – 13.5; Japan – 10.3.

Silicon products:

- Russia – 1.0; USA – 50.4; EU – 48.9.

2.1. GLOBAL PETROCHEMICAL AND GAS-DERIVED CHEMICALS INDUSTRY DEVELOPMENT TRENDS

It should be noted that among the world's multi-industry complexes, one of the major parts is played by the petrochemical and gas-derived chemicals industry (PCGDCII) being a component of the chemical industry, which is based on oil refining products, gas condensate, associated petroleum gas and natural gas processing products. Over a relatively short period of history, the PCGDCI has won strong positions virtually on all continents, having from 5% to 10% share in the economy of many countries. In most countries of the world, the petrochemical and gas-derived chemicals industry is a fairly advantageous business object, and this fact results in its high growth rates. Generally, the production of petrochemical products and gas-derived chemicals is profitable, and by the level of its profitability index, it is just a little inferior to the most profitable sectors of the modern business.

The PCGDCI has a high economic, ecological and social effect. Profitability and its growth rate indicators suggest that the PCGDCI is cost effective. One may judge about its environmental friendliness by little-waste or waste-free petrochemical and gas-derived chemicals production facilities, use of petrochemicals for improving the quality of motor fuels, treatment of water, air and other elements of the environment. Social significance of the PCGDCI involves the establishing of new jobs both within the sector itself and raw material and consuming industries relating to it.

The PCGDCI is a link between the oil and gas sectors complex and processing industries (machine-building industry, aerospace industry, telecommunications, etc.). The PCGDCI is a part of the chemical complex and, consequently, may be referred to the processing industries. However, it is also a part of the oil and gas complex being a component of world's major oil and gas companies.

Sectors of the petrochemical and gas-derived chemicals industry (they are called " the petrochemical and gas-derived chemicals wings of oil and gas companies" sometimes) play a significant part in the operation of quite a number of such companies. The development of petrochemical sectors is one of the indicators of company's diversification level, sustainability of such companies. In the net sales of the largest oil and gas companies, such as Exxon Mobil, British Petroleum, Royal Dutch Shell, Total, Chevron-Texaco, Conoco Phillips and some other, the share of petrochemical and gas-derived chemicals industry reaches 10% and more. In the modern global PCGDCI, not less than a half of the produced products (from source semi products, including petrochemicals and gas-derived chemicals, to such end products as plastics, resins, synthetic rubbers, chemical fibres) is produced by oil and gas companies. At the same time, a role of specialized companies of petrochemical and gas-derived chemicals industry's profile grows globally, and real configuration of this sphere of activities in some countries and regions is determined by many factors.

Unfortunately, over the recent decade, in Russia, total output of many types of petrochemical products and gas-derived chemicals has dropped, technical level has decreased, the lagging behind not only the leading countries (USA, Japan, Western European countries) but also the developing countries (China, South Korea, Brazil, Saudi Arabia, etc.) has started to become more and more grave. Taking into account global trends, as well as given the goal of increasing the level of diversification, profitability growth and, what is the most important thing, given the intention to range among the world's largest oil & gas and petrochemical & gas-derived chemicals industry giants, it appears that in Russia, both leading oil and gas companies and SIBUR being the major company specializing in the CROGRPGDCI complex should increase their significance, facilitate the domestic petrochemical and gas-derived chemicals industry coming out of the recession.

Today, the total revenue from sales of the global petrochemical products and gas-derived chemicals constitutes about USD3 bn, which is comparable to the cost of products of the world's oil market.

To make the picture complete, let's supplement the brief review of the global petrochemical and gas-derived chemicals industry set out above, with comparing tendencies of the development of the world and domestic industries.

As far as such trends as globalization, consolidation and integration are concerned, they are typical for both the global and domestic petrochemical and gas-derived chemicals industry. Russia participates actively in the world trade in petrochemical products and gas-derived chemicals. In Russia, as in many other countries, consolidation and integration processes take place, merger & acquisition transactions are effected, the of petrochemical products and gas-derived chemicals market becomes oligopolistic.

As to other remarkable tendencies, a noticeable divergence from global petrochemical and gas-derived chemicals industry is observed here. It primarily relates to the trends in changes in the breakdown of the products being produced. While a clear tendency for increase of a share of highly complicated science-intensive products exists within the global petrochemical and gas-derived chemicals industry, and this tendency is typical for the petrochemical and gas-derived chemicals industry of the developed countries and is becoming visible in a number of developing countries as well, the specific feature of the Russian petrochemical and gas-derived chemicals industry is the production and export of low process stage products. The matter is that in the global petrochemical and gas-derived chemicals industry, the production of higher process stage products is connected with the raising of production efficiency, and in the Russian petrochemical and gas-derived chemicals industry, due to lack of modern process plants operating at higher process stages, the production of low process stage products is more profitable.

Innovations (new technologies, products, management practices, etc.) are the core driver for the global petrochemical and gas-derived chemicals industry; in the domestic petrochemical and gas-derived chemicals industry, the role of the innovation component is still insignificant. In this sphere, outdated technologies, products, methods of production management are still preserved. In many aspects, it results from the R&D role which is permanently increasing in the global petrochemical and gas-derived chemicals industry and was minimized within the Russian petrochemical and gas-derived chemicals industry, especially in the 1990-ies.

The modern global petrochemical and gas-derived chemicals industry is based on large single aggregates, so called mega-plants securing favourable technical & economic performance due to high technical equipping and the 'economy of scale'. There are no mega-plants in the Russian petrochemical and gas-derived chemicals industry so far.

In the global petrochemical and gas-derived chemicals industry, the taking into consideration of an ecological factor became a mind-set of top-managers of the sector. Much money constituting from 10% to 15% of an overall project value in general is spent on environment protection arrangements. In the Russian petrochemical and gas-derived chemicals industry, similar attention is not given to the environment protection issue.

Virtually, at all phases of development of the global petrochemical and gas-derived chemicals industry, growth rates of the sector have been higher than those of GDP. Such "advance coefficients" were characteristic of the domestic petrochemical and gas-derived chemicals industry in the Soviet times only.

The global petrochemical and gas-derived chemicals industry is a cost-efficient business. If it were not so, petrochemical and gas-derived chemicals production facilities wouldn't sprout like mushrooms after the summer rains. Investors are readily investing funds in designing and construction of facilities of petrochemical and gas-derived chemicals industry. Specialized petrochemical and gas-derived chemicals companies and oil and gas companies are investing rather actively. So far, both domestic oil and gas companies and global institutional investors would manifest minor interest to the Russian petrochemical and gas-derived chemicals industry.

Within the global petrochemical and gas-derived chemicals industry, the dynamics of oil and gas prices have rather a strong effect. Despite the fact that no direct proportion between the changes in prices for petrochemical products & gas-derived chemicals and oil & gas prices has been revealed, however, when prices for raw materials grow, the prices for petrochemical products and gas-derived chemicals would increase, and when they are going down – the latter prices are decreasing as well. In the Russian petrochemical and gas-derived chemicals industry, prices for the sector products are continually growing.

In the global petrochemical and gas-derived chemicals industry, prices for the sector products are formed on the market under the influence of many factors, first of all, the demand and supply ratio, and oil price dynamics. The same market mechanisms are typical for the domestic industry. However, in a number of countries, especially in those having raw hydrocarbon deposits, government authorities regulate the raw material prices, keeping them at a fairly low level, thus facilitating the cheapening of the petrochemical products and gas-derived chemicals and increasing their competitiveness on the market. In the domestic petrochemical and gas-derived chemicals industry, no expansionary steps aimed at speeding up of its development are taken.

The petrochemical and gas-derived chemicals industry is a serious driver of modernization of the economies in many countries of the world. The petrochemical products and gas-derived chemicals substitute many traditional materials, thus updating the production structure of the economies. Within the framework of the petrochemical and gas-derived chemicals industry, new materials with predetermined features are created, its products facilitate the resolving of the energy-saving issue; petrochemical products and gas-derived chemicals are a feedstock for quite a number of high-tech sectors, they are interrelated closely with the production of pharmaceuticals and biotechnologies. In this connection, petrochemical and gas-derived chemicals industry is certainly one of the priorities of the development in many countries of the world.

2.2 EXPORTED AND IMPORTED PRODUCTS

Export product mix of Russia's chemicals sector complex is presented largely by products of lower and average degree of technological conversion, which is used for further conversion into the products with higher added value. Key products having an export potential are: mineral fertilizers – 35%, synthetic rubber – 9%, ammonia – 5% (24% of its output), methanol – 2% (53% of its output).

Unlike the export, the product mix of the Russian import is diverse, and goods having high added value traditionally prevail in it.

The comparing of the product structure of the Russian export and import shows that low process stages chemicals are predominantly exported from the country and advanced process stages chemicals (catalyst agents, plasticity agents – about 35%, plastic products – 23%, plastics and resins – 19%) are imported.

According to the RF Federal Customs Service (FCS), the total import of chemical products constitutes about USD33 bn, or 18% of total import of goods to the RF.

Basic forecasts for the development of the chemical industry and petrochemical industry within the framework of the global economy are extremely positive, and by 2030, according to authors' estimates, the situation would be as follows:

- the share of the sector in the global GDP would increase from 3.2% (20007) to 7.4%;

- overall production would growth from USD2,134 bn (2007) to USD 6,800 bn;

- production growth rates in 2030 would be 2.5%;

- consumption growth rates in 2030would be– 3.6%.

Meanwhile, output of the primary petrochemical products sector is forecasted to increase by 2030 insignificantly just by about 18%.

In 2008, Russia ranked No.20 by chemical products output; Russian enterprises produced 1.1% of the global chemical products volume. At the same time, Russia is one of the world's leaders in production of mineral fertilizers – it is No. 3 in this sphere, synthetic rubbers – No. 4 in the world (10%). At the same time, Russia is No. 13 by production of polypropylene (1.3% to 1.7%), other chemical products – No. 19 (1%).

2.3 GLOBAL MARKETS SEGMENTATION

Specific features of the development and geographical distribution of the world chemicals sector make it possible to identify several large regions where sector enterprises are concentrated:

- Western Europe producing 32% of the global chemicals sector products (by cost) is characterized by a large share in production of science-intensive expensive products (synthetic dyes, lacquers, special chemicals) and the production of export-oriented products (40%);

- North America (about 30% of the global production, with the US share of 26%). Countries of the region have their own solid raw materials resources for the chemicals sector. The USA and Canada set aside as world's major producers and exporters of mineral fertilizers, blasting materials, synthetic and polymeric materials;

- Asian region is an evolving region with the booming chemical sector (40% of the global chemicals consumption, approximately 30% of chemicals output). Today, Japan cuts down the production of cheap petrochemicals and continues to develop science-intensive sectors. The chemical industry is soaring in China where heavy chemicals production prevails, and plastic materials, chemical fibres and synthetic rubber production is on the upswing;

- Asia, Africa and Latin America are fast-paced, especially, in the countries having their own large oil and gas resources. So, in Persian Gulf countries, Indonesia, Venezuela and other states, many enterprises engaged in production of nitrogenous fertilizers and petrochemical semi-finished products, producing products for export were built. A giant complex of petrochemical enterprises in the Persian Gulf region (Saudi Arabia, United Arab Emirates, Iran, Kuwait) is Russia's main competitor.

General development tendencies of both global and domestic CROGRPGDCI are similar by many parameters, but, of course, they differ in individual countries and regions, depending upon

their position in respect of available resources and the parts they play at various elements of the product chain.

2.4 TECHNOLOGICAL LEVEL OF THE RUSSIAN CROGRPGDCI

When considering a whole chain of processes of the oil and gas resources processing and petrochemical and gas-derived chemicals industry, one should acknowledge that in Russia, the existing production potential is concentrated at the initial production and raw materials processing phases and is resource oriented. The industry produces and exports primary resources, energy commodities and products of their processing, importing end products of processing and manufacturing industry.

Recently, rates of development of scientific & technological research have been growing, compared with the previous periods; however, these research works are not systematic, and their scope remains rather small if compared with countries-competitors.

The challenge of retaining and increasing business efficiency is not only to carry out modernization and structural reconstruction of existing production facilities but also to transfer to new technological principles enabling to modify oil and gas industry raw materials base, practices of maintaining and computer modelling of the chemical process and, thus, eliminate the contradictions between the resource-related opportunities and resource intensity of the production processes and facilities.

2.5 RUSSIAN CROGRPGDCI OUTPUT GROWTH POTENTIAL

The need to improve competitiveness of the domestic chemicals industry complex requires to focus today on the following key lines:

- **expanding the production of initial monomers, and providing the relevant production facilities with feedstock, and starting the production of marketable products;**
- **development of subsequent process stages being used for the production of end products;**
- **development of low-tonnage special and consumer chemicals industry.**

In the long-term, using a method of situation modelling, probabilistic potential of production of petrochemical products should be determined, depending upon the stated national development strategies of key consumers, having calculated a growth potential of end products consumption on

the basis of the production of chemicals (plastics, synthetic rubber, organic chemicals), with determining the necessary volume of petrochemical and gas-derived chemicals industry feedstock.

Expansion of product output and consumption markets by means of import substitution, developing export of Russian-made products to CIS countries, raising the consumption level to the statistically average world level should be the basis for the development of the sectors being considered herein.

Our look-ahead calculations relating to the building up of the domestic demand for petrochemical and gas-derived chemicals industry products, pluriannual, for the period of up to 2015 and 2030 in comparable 2006 prices, have shown that the domestic market capacity would increase more than twice, and by 2030 - more than five-fold.

A current paradox: the increasing domestic market demand for the products of the chemicals complex is being formed due to the products having high consumer properties, and such growth is covered by consistently increasing imports of chemical products. **In 2008, the total volume of Russia's chemicals and petrochemicals complex products output was equal to USD51 bn, product exports – USD21 bn, imports – USD33 bn. In other words, products for USD30 bn are produced for the domestic market, and accounting for the imports, the domestic market capacity was equal to USD 63bn in 2008.**

As a result of the global financial and economic crisis, producers of chemicals have experienced double pressure: on the one hand, a sharp drop in the demand for their products caused a decrease of their profit (major chemicals consumers – car and construction industries - failed to maintain the former consumption level), and, on the other hand, it turned out to be rather difficult for many companies to obtain a loan in order to improve their financial position.

The basic signs of the sector crisis are a double or three-fold drop in output on the average, shutdown of a number of production facilities, shrinkage of the capacity of domestic and external markets, the decreasing of innovation & investment activities 1.5 times, fall in prices 2.5 times, drop in the profit by 40% on the average.

The deleterious effects of the crises were failed to be overcome so far. The pre-crisis level of product output for certain items may be reached in 2011.

2.6 GLOBAL REQUIREMENTS TO, AND INSTITUTIONAL LINES OF PETROCHEMICAL AND GAS-DERIVED CHEMICALS INDUSTRY DEVELOPMENT

International focus on the chemicals sector (including oil refining and gas refining industries) has been growing from year to year and is based on a number of global documents

adopted at the level of the UN, Organization for Economic Cooperation and Development, International Labour Organization, World Health Organization, major international and national conferences relating to ecology, technical regulation and industrial safety, and use of petrochemical products and gas-derived chemicals.

Essential changes in the global policy in the sphere of safety of relevant production facilities and oil refining and petrochemical products and gas-derived chemicals, as well as ignoring these issues in this country brings Russia to the level of underdeveloped countries, and the loss of competitiveness of end products both on international and further on, on national markets, is pending.

The institutional line of the sector development is the system of measures aimed at focusing the development of raw material industries (oil and gas production and oil refining and gas processing) on deeper processing of such materials (petrochemical and gas-derived chemicals industry, chemicals, etc.), and on the basis of the Four Priorities for the Nearest Quadrennium (institutes, infrastructure, innovations, investments) aimed at introducing technological innovations in such sectors which would have a positive effect on the raw material-related component of the economy, improving competitiveness of Russian enterprises, focusing efforts on consumer properties of the products, launching the processes of integration, cooperation and differentiation of the sectors consuming chemicals. It determines the principal strategic goal of the sectors operation for a long term and ensures its development adequacy to the socioeconomic processes occurring in the society.

Preparation of Russian export-oriented enterprises to ensuring compliance with REACH European Regulations has revealed material problems in the sphere of product examination for safety. Throughout the world, the technical regulation pertaining to chemicals safety is transferring to an absolutely new regulation level, which shall become a significant factor for planning further development of the Russian industry.

The developing countries (for example, China and Saudi Arabia) arrange their development through government regulation of the principal processes accompanying petroleum products and chemicals production. This is determined by the lack of long-established civil society institutions and relevant regulatory basis being capable to ensure the appropriate regulation of hazardous production facilities and end products.

One of the major issues in the development of markets of petrochemical products and gas-derived chemicals is a low investment, innovation, organizational activity in the sector, which, at remaining orientation at the continuance of moderately-rated development of the petrochemical and gas-derived chemicals industry at the expense of increasing the load of the existing capacities and their partial reconstruction or episodic capacities built-up, would lead

to inability of the domestic production sector to satisfy growing domestic demand which would gradually get back to pre-crisis growth rates. Import volumes in respect of the most important product items will grow as it has been before. In this connection, it would be necessary to carry out a speedy modernization of gas processing and gas chemical enterprises, formation of new major centres of gas-derived chemical industry. In this case only Russia would satisfy the needs of the developing economy in polymers and other products of advanced process stages and, possibly, secure the entering into relevant segments of international markets.

In the opinion of the authors of the research, to ensure efficient development of the Russian economy, there should fully used the resources of the country, its existing potential and skills of engineering & technical personnel and regular labour force. The analysis showed that such development, to a significant, if not in to critical extent, should be based on transition from a raw material component to the industry development lines relating to further technological conversions from the raw materials to end products.

The first steps towards the structural development of the sectors under review, should be based on consistent expansion of capabilities of the oil refining and, especially, gas refining industries in sales of their products and using them at the Russian enterprises of the petrochemical and gas-derived chemicals industry, which should facilitate a material, at the first phase, increase of volumes of product output at the enterprises of the petrochemical and gas-derived chemicals industry facilities.

The state can and should further the intensive development of the petrochemical and gas-derived chemicals industry by means of:

- stimulation of domestic demand for petrochemical products and gas-derived chemicals by means of changing/introducing new technical standards in consuming sectors, implementing new requirements in the spheres of energy saving and environmental friendliness, forming the industry consuming standards;
- rendering assistance to business in raising sufficient financing, accounting for economic efficiency;
- revitalizing sectors of low-tonnage chemicals industry connected with the production of catalysers, products of reactive and special chemicals sector which are widely used at all conversion stages from oil and gas to end products;
- involving entrepreneurship in the expansion of semi-finished products processing and development of consumer chemicals industry;
- optimization of technical regulation in the sphere of capital construction;

- changing/ introducing new technical standards in consuming sectors, implementing new requirements in the spheres of energy saving and environmental friendliness, forming the industry consuming standards;
- supporting the import of RF petrochemical products and gas-derived chemicals on the global market.

2.7 ON DEVELOPMENT OF CERTAIN MARKETS FOR PETROCHEMICAL PRODUCTS AND GAS-DERIVED CHEMICALS

A more detailed review of the issues and ways of their resolving, in respect of markets for a number of specific product groups of petrochemical and gas-derived chemicals industry, is given below.

Raw materials base. For Russia, the major gas producing country, the long-established structure of the raw materials base of the petrochemical and gas-derived chemicals industry is strange to a certain extent. Straight-run gasoline fractions (naphtha, according to Western terminology) are predominant there, which is more typical for oil importing countries.

Enormous resources of valuable hydrocarbons of natural (rich in ethane) gas, associated petroleum gas and gas condensate are used in a minor way in the Russian petrochemical industry.

The setting up of gas-derived chemicals sector facilities on the basis of valuable hydrocarbons of natural and associated petroleum gas is fairly promising in Russia. One of the possible facilities could be Severny Marshrout ('Northern Route') project providing for the construction of a number of gas-derived chemicals sector facilities at gas transmission mainline Urengoi – Nadym – Punga – Ukhta – Gryazovets, with subsequent division into streams towards Moscow and Saint-Petersburg, using valuable hydrocarbons educed from the natural gas (ethane, propane, butane, hydrocarbons C_{5+B}). The essence of the project is to dedicate an autonomous pipeline within the Urengoi – Saint-Petersburg gas transmission system for transportation of ethane-containing gas, installation, along the route, of plants for extracting valuable hydrocarbons, pyrolysis of ethane, propane and normal butane, production of ethylene and propylene, polyethylene, polypropylene and other petrochemical products from the gas. At the proposed points of location of gas-derived chemicals sector facilities (one of them is Cherepovets, a site of Azot Cherepovets Plant), as well as in district centres and small towns, in particular, in the Vologda Region, small enterprises specializing in plastics processing could be set up. An end point of the line may become a city of Vyborg where establishing of the gas-derived chemicals sector facility for satisfying needs of North-Western Okrug, and for export, is justified.

This project, having been designed once for Gazprom, didn't join the ranks of priority projects of the gas giant, despite the fact that the advantages of the project are evident. Projects of the similar type can be implemented in other regions of the country. In particular, in the Eastern Siberian region, plants for extracting valuable hydrocarbons from the gas and production, on their basis, of ethylene and propylene, could be set up on the basis of the largest Kovykta and a number of other gas condensate fields, especially, for providing with raw materials the large facilities of the petrochemicals industry complex in the cities of Angarsk and Sayansk, and for further development of the petrochemicals sector in the region. There are similar opportunities in the Northern Caspian Sea region where a number of gas condensate fields were discovered, as well as in other regions of the country. This is the way of transformation and expansion of raw materials base of the petrochemical and gas-derived chemicals industry, eliminating feedstock-related limitations for its further development.

Basic organic semi-products. An insufficient development of the production facilities for basic organic synthesis products should be noted. The today's core issue, in addition to the development of particular petroleum or gas-derived chemicals production facilities, is the necessity of making investments simultaneously in a number of production facilities specializing in semi-products. For example, the feedstock for enterprises producing polymers are basic products of primary hydrocarbons processing (low molecular weight olefins, ethylene, propylene, butadiene, polynuclear aromatics (benzene, toluene), etc.), rather than primary hydrocarbons themselves. And the growing needs of enterprises producing polymers (polypropylene, polyethylene, polystyrene), within the framework of just listed basic semi-products, restrict other organic synthesis sectors, for example, producers of ethylene glycol, vinyl-acetic ester, acrylonitrile, phenol, butyl alcohol, hexamethylene, access to these raw materials. Presently, a deficiency of the former, i.e. basic organic synthesis products, is observed in the country. In order to increase their output, it would be necessary to process larger amounts of raw hydrocarbons in pyrolysis furnaces and other chemical reactors. However, the capacities of furnaces and chemical reactors available are already extremely overloaded. That is, in order to develop petrochemical and gas-derived chemicals industry, it would be required to set up a solid basis for the production of basic organic semi-products (primarily, low molecular weight olefins and polynuclear aromatics).

A potential threat resulting from insufficient development of production of basic organic products, is that, after the recovery of the demand after the growth rates for gas-derived and petrochemical products to their pre-crisis level, given the conservatism of Russian investors, one should anticipate an avalanching increase of presence of foreign goods in the form of many types of petrochemical products and gas-derived chemicals, especially, in polymer segment, on the Russian

market. Table 1 shows that imported products account for a significant share of domestic consumption in Russia.

Table 1. Share of Import in the Consumption of Synthetic Resins and Plastics on the Domestic Market of the Most Significant Types of Products of Chemicals Complex for 2006 - 2010, %

Item	Measurement unit	2000	2006	2007	2008	2009	2010, estimate
Imports	thou. tons	613.6	1,664.8	2,058.7	2,136.5	1,508.5	1,900
Share of imports in overall consumption	%	25.7	33.7	34.7	36.4	30.4	34.2

Source: Data of BusinessInfoResurs Information & Analytical System.

Taking into consideration intensive penetration of imported products into the chemicals sector, especially, into the polymer plastics segment, it would be necessary to intensify the system-based support measures for this strategic line.

An increase of the demand for petrochemical and gas-derived chemicals industry products could be achieved by means of a **cluster form of organization of petrochemical and gas-derived chemicals industry** complexes, as well as through the diversification of petroleum and gas-derived chemicals production facilities. In this case, the added value would stay within the framework of the competitively-friendly economic system, and develop itself. The development of a deeper processing of basic semi-products into the semi-products of subsequent process stages and end consumer products, should be Russian enterprises' strategic goal. The setting up of innovation clusters, among other things, by using mechanisms of encouraging small and medium-sized business creation on the basis of large enterprises as a result of development of necessary infrastructure and coordination of actions of state-run and private companies. Role of the state is to provide sites for arranging special economic areas, tech parks, business incubators, development of basic infrastructure, and to create conditions for attracting investments (using government funds and public-private partnership funds).

Generally, when considering issues of CROGRPGDCI complex, one should not separate prospects for **import substitution from the development of export lines**, since the latter can speed up the development and making of the entire Russia's modernized petrochemical and gas-derived chemicals industry. In this connection, let's discuss briefly export markets prospects.

According to Nexant Consulting Agency, a global picture of the trade in the medium term (up to 2025) would develop as follows: upon the restoring of pre-crisis consumption growth rates, the USA and Western Europe (except for Germany) most probably would become major net

importers of petrochemicals and gas-derived chemicals, especially, polyolefines, such as linear low density polyethylene (LLDPE), high density polyethylene (HDPE) and polypropylene, except for low density polyethylene (LDPE). It is partly connected with the falling of profitability and compulsory shutting down of old and less competitive capacities.

Middle East countries became key suppliers of the mentioned above products, however, a part of the international market may be won by Russia also. The building of a petrochemical facilities at the Baltic Coast, which may bring Russian producers into proximity with Western European markets and make cheaper the transportation of end products by sea, may become one of our advantages.

The use of light hydrocarbons having been already mentioned above, especially, ethane for producing ethylene and the products on its basis, may become yet another advantage. **It is believed that in the Middle East, a speedy decrease of ethane component content in the total volume of produced feedstock is taking place, however, just using the ethane provided a competitive advantage in respect of a cost price of ethylene and its derivatives, which allowed the petrochemicals produced in this region to win the markets.**

Moreover, in the situation of highly developed chemicals sector in the Middle East countries, the latter are currently net importers of polyvinyl chloride (PVC), which materially decreases a potential competitive pressure of this region on the global market. High expenses related to chlorine transportation discount their advantages in the raw material prices. **Russia having such raw materials in abundance, in its turn, can take advantage of this competitive edge**.

Many Asian countries (China, in particular) still would remain to be net importers of polyethylene and polypropylene for rather a long time yet. China is a net importer of LLDPE polyethylene, HDPE and polypropylene. In 2008, import of polyethylene of various density, according to some reports, was from 4.8 million to 5 million tons and import of polypropylene constituted about 3 million tons. At the same time, in China, as far as PVC is concerned, the demand potential for this product has been exhausted due to multiple increase of capacities there of late.

Synthetic Resins and Plastics. The main problem of this sector of the petrochemical and gas-derived chemicals industry is that after the recovery of the demand growth rates for gas-derived and petrochemical products to their pre-crisis level, given the conservatism of Russian investors, one should anticipate an avalanching increase in presence of foreign goods in the form of these and many other types of polymers on the Russian market. At least, almost 2 million tons of synthetic resins and plastics is already being imported now, and even more is imported in the form of goods made of plastics and synthetic resins.

To force out foreign producers from the Russian market of end products would be the most difficult task.

In 1990s, because of large-scale importing of durables to Russia (automobiles, household appliances, furniture), for production of which much plastics is used, a visible recession was observed on the plastics domestic market. Despite the crisis, foreign producers didn't lose their interest in the Russian market as the one having the highest potential. Seeking to cut down costs for their products sale by means of decreasing transportation costs and customs tariffs, many major foreign producers of automobiles (and household appliances) continue winning the Russian market and investing in its certain sectors. Over the recent years, assembly factories have been built and production lines for manufacture of many foreign automobiles have been set up in the country. The above specified enterprises purchase most of their components abroad. We believe that government support in the form of granting privileges to foreign automobile assembly plants should be provided on a condition of purchasing by the latter of polymer materials and components in Russia.

When choosing priority development lines, Russian plastics producers are not recommended to adhere strictly to short-term tendencies of demand and consumption on the chemicals market or simply follow the global trends. The demand for such synthetic resins and plastics as polypropylene, LDPE, PVC on the part of the construction and packaging industries attracted large investment volumes in 2000-ies. However, already in 2006, there appeared first signs of stagnation in the construction industry being a key consumer of goods made of above mentioned polymers, *inter alia*, the ones used in the production of vinyl windows and linoleum. It would be possible to avoid such scenario through the planning of investment activities, orienting also at alternative centres of consumption growth.

At the present stage, certain production facilities and whole sub-sectors which could satisfy the domestic demand, are lacking in Russia. Over a half of Russian consumption is covered by import deliveries of the following groups of polymers: linear low density polyethylene, polyethylene terephthalate (PET), polyurethane, polycarbonate, fluorocarbon resins, including polytetrafluoroethylene (Teflon), polybutylene terephthalate, as well as various silicon polymers.

However, it is rather difficult sometimes to identify alternative centres of consumption growth for polymers. Taking into consideration this factor too, it would be necessary for the government to initiate implementation of national projects for construction of affordable housing and infrastructure facilities, housing and utilities sphere, gasification with guaranteeing government financial support for enterprises operating in such sectors.

Extension of loans to consuming industries, as well as small and medium-sized businesses (for example, the ones engaged in plastics processing) would not only revitalize the

petrochemical and gas-derived chemicals industry and chemicals sector, but would also allow to process the increasing volumes of raw hydrocarbons (LPG).

Besides, when looking up to export markets, it is not worth changing sharply a profile of future investment projects for the construction of facilities producing traditional high-tonnage polymers. Proceeding from regional processes taking place in the global economy, diversification of export deliveries, *inter alia,* shifting from overheated and partly stagnating European market to dynamic Pacific markets, would be possible.

Synthetic Rubbers. In Russia, the production of synthetic rubbers is export-oriented as well. The exports share in the production is equal to 60%. Large-scale technological re-equipment of a number of production facilities of Russian tire and general mechanical rubber goods industry would allow to increase the demand for the rubbers.

A profile of the products produced by sector enterprises constitutes a particular problem of the modern state of synthetic rubbers line. Today, the mix of synthetic rubbers and latexes produced in Russia differs from the world one. Abroad, the most popular are butadiene & styrene rubbers and latexes, as well as special purpose rubbers (nitrile, ethylenepropylene, chlorbutadiene, butyl rubber, siloxane ones, etc.). In the domestic industry, so called polybutadiene and polyisoprene resins are dominating, and their share is equal to 50%, and butadiene & styrene rubbers (about 30%) and special resins and latexes (15%) are also produced on a mass scale.

Expansion of product mix and changes in the structure of produced rubbers by means of increasing special purpose rubbers and butadiene & styrene rubbers output, may become an impetus in resolving this issue.

2.8 OVERVIEW OF MARKETS FOR METHANE(C_1)-BASED PRODUCTS OF GAS-DERIVED CHEMICALS INDUSTRY IN THE RF AND OPPORTUNITIES FOR THEIR DEVELOPMENT

The basic component of natural gas is methane being a valuable, highly efficient fuel. At the same time, it serves as the basis for gas-derived chemicals industry processes based on methane processing which, of late, has become an independent sector, having even put competitive pressure on petrochemicals industry in some segments. It is common practice to refer to this sector's products such chemicals as ammonia, urea, ammonium nitrate, and then, methanol, acetic acid, formaldehyde (formalin), methyl tertiary butyl ether, resins on the basis of formaldehyde processing and products resulting from processes of converting gas into liquid fuels (on the basis of gas to liquid technologies, or GTL).

Gas-derived chemical fertilizers. Ammonia is used as a primary component for nitrogenous fertilizers production. Mineral fertilizers industry was set up in this country to cover domestic agricultural sector needs. In 1980-ties, the agricultural sector consumed over 90% of fertilizers; however, in 1990-ties, their quantity decreased. In recent years, competition has grown on the international market, and, in this connection, sectors inside Russia have been subjected to production facilities consolidation processes, and 6 vertically integrated entities have been established. Steps taken by the private business and the government facilitate the increase of fertilizer consumption on the domestic market and their shifting from external markets.

Urea is a traditional export product and is used by agricultural producers in Russia just on a small scale, which is explained by its higher cost than the cost of, say, ammonium nitrate, and low buying capacity of domestic agricultural producers. In 2008, about 2 million tons of urea were exported from Russia, which constituted almost 80% of the production volume, see Table 2.

Table 2. Dynamics of Urea Output in 2002 - 2009; thou. tons/year

Item	2000	2006	2007	2008	2009
Output	1,994.0	2,464.5	2,558.6	2,437.4	2,684.7
Exports	1,860	2,140.7	2,122.4	1,934.9	2,200.2
Imports	106.1	26.6	n/a	n/a	n/a
Apparent consumption	240	350	435.7	502	484
Exports share in the output, %	93.3	86.9	83	79.4	82
Imports share in the consumption, %	44.2	7.6	n/a	n/a	n/a

Source: Data of BusinessInfoResurs Information & Analytical System.

Ammonium nitrate. Over many years, ammonium nitrate production capacities have not been increased because of complexities relating to executing documents and check-ups of all sort when exporting this hazardous product, and the capacities remained stable up to 2002. Presently, the capacities are, nevertheless, being built up due to popularity and low cost of this product. Its exports over one year (from 2008 to 2009) have grown by 47%, see Table 3.

In the situation of economic crisis, ammonium nitrate became popular among agricultural producers of the whole world. Due to its high agrochemical properties and relatively low price, agricultural producers are inclined to purchase right this fertilizer.

Table 3. Balance Sheet Ratios of the Production and Consumption of Ammonium Nitrate During the Period from 2000 to 2009; thou. tons/year

Item	2000	2006	2007	2008	2009
Output	2,040.3	2,266.3	2,340.3	2,469.5	2,902.9
Exports	1,205.1	1,171.2	1,050.0	1,035.0	1,531.5
Imports	1.2	0.6	1.0	1.8	3.0
Apparent consumption	836.4	1,095.7	1,291.3	1,436.2	1,374.4
Exports share in the output, %	59.1	51.7	44.9	41.9	52.8
Imports share in the consumption, %	0.1	0.1	0.1	0.1	0.2

It should be noted that the referring of ammonium nitrate to explosives has closed a number of large sales markets for it. Of late, some countries suspended or prohibited import of this product to their territory. These countries are China, Columbia, Iran, Philippines and Brazil.

Methanol is a high-tonnage ROGRPGDI product. In 2008, 53% of methanol produced in Russia was exported. In 2009, there occurred a decrease of the exports share to 34.7% due to declining demand on external markets. Currently, nine major Russian producers produce methanol. The year 2009 showed 50% drop in production, compared with 2008 (Table 4). For 2010, an increase in the demand is predicted, however, it is not clear whether the previous output and consumption levels would be restored.

Table 4. Balance Sheet Ratios of the Output and Consumption of Methanol in 2000 - 2009; thou. tons/year

Item	2000	2006	2007	2008	2009
Output	1,915.9	3,161.7	3,542.2	3,514.5	2,346.6
Exports	871.7	1,571.1	1,601.6	1,862.9	814.8
Imports	0.0	0.0	0.0	0.0	0.0
Apparent consumption	1,044.2	1,590.6	1,940.6	1,651.7	1,531.8
Exports share in the output, %	45.5	49.7	45.2	53.0	34.7
Imports share in the consumption, %	0.0	0.0	0.0	0.0	0.0

Despite the fact that during the pre-crisis period, methanol was produced at a growing rate in Russia, in 2008 - 2009, because of the economic crisis, drop in production of this product was

observed almost at all enterprises producing methanol. **In order that to sit tight, we need a new development strategy**. Over the period from 2006 to 2009 being under review, the level of utilization of capacities for methanol production decreased, which was only partially caused by the worsening of external market environment for the methanol. At the present stage, the Russian methanol market directly depends on global business situation that showed its extreme volatility.

To resolve the issue, Russian producers will have to **switch** from selling it as an end product **to the production of products of further process stages**. The decision on building up output of urea formaldehyde concentrate (UFC) was considered right after the plants have started to produce the feedstock for its production, i.e. methanol. During pre-crisis times, urea formaldehyde resins consumption grew very fast (13% per year). Binding materials made on their basis are used largely for the production of chipboards, medium density fibreboards (MDF) and plywood, which 75% of modern furniture is made of. For this reason, the furniture industry could become a key driver for increase of consumption of these materials. New projects for production of formaldehyde, urea formaldehyde concentrate, melamine, acetic acid, except for methyl tertiary butyl ether (MTBE) would facilitate the domestic market expansion. In connection with the incident involving MTBE spillage in the USA having occurred a number of years ago and a world tendency for transfer to pollution-free additives, MTBE will be gradually replaced by ethyl tertiary butyl ether (ETBE).

In addition to these lines of activities, in the nearest future, relative sustainability of the domestic market will be secured by the very segment of methanol consumption, in which it is used as a substance preventing the formation of hydrates (species of water and hydrocarbons in pipelines) at the gas production and transportation. The major methanol consumers are Gazprom OJSC, SIBUR OJSC, etc.

In the light of diversification of nitrogenous fertilizers plants operation, the prospects for developing gas-derived chemicals industry on the basis of the natural gas consisting primarily of methane, are inviting. Large capacities for nitrogenous fertilizers production having been created as early as in the Soviet times, are not currently utilized in full. The reasons are: decline in the domestic consumption of nitrogenous fertilizers and potential difficulties related to export due to gradual decreasing of competitiveness of fertilizers resulting from growth of prices for gas and setting up large production facilities in the countries being major consumers of Russian nitrogenous fertilizers.

In this connection, it would be possible to build new GDCIPs or diversify operation of the existing nitrogen plants in order to efficiently use methane by means of introduction of new technologies and implementation of new gas-derived chemicals industry projects. Schematic diagram of a GDCIP based on methane resources, is shown in Fig. 6.

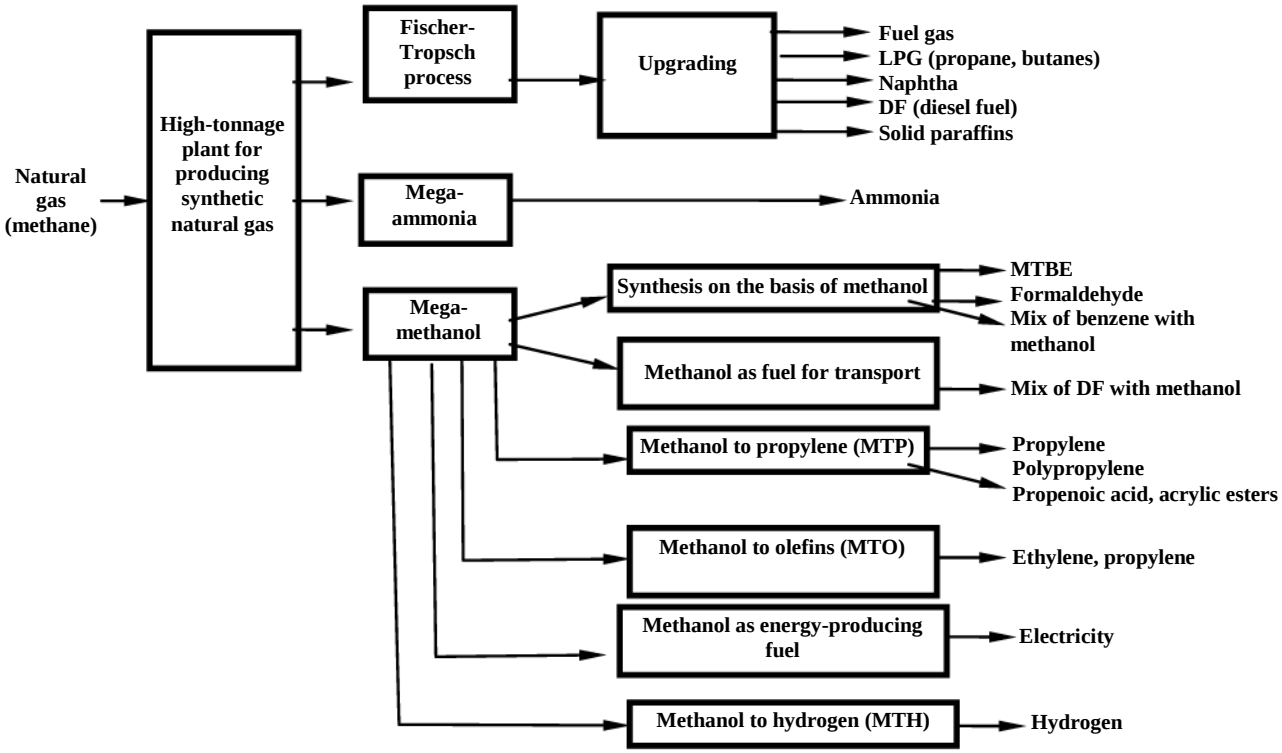

Fig. 6 Conceptual Scheme of GTL High-Tonnage (Gas to Liquid) and Gas-Derived Chemicals Processes on the Basis of Methane

In the diagram above, there were combined the concept of consolidation of capacities (mega-methanol, mega-ammonia) allowing, due to the economy of scale, to improve economic performance significantly, and the concept of introduction of fundamentally new technologies (GTL, or 'Gas into Liquid', for producing pollution-free motor fuels and high-molecular paraffins and ceresines; MTO or 'methanol to olefins' allowing to produce ethylene, propylene and their derivatives; producing dimethyl ester, an adequate substitute of diesel fuel; MTH or 'methanol to hydrogen').

At GDCIPs using methane as a feedstock, the best technological solutions of well-known gas-derived chemicals industry firms could be used. In particular, various technologies of propylene production: in the course of catalytic cracking at oil refineries; by hydrogenation of propane, using 'methanol to olefins' and 'methanol to propylene' methods, as well as olefins conversion methods (disproportionation and cracking of olefins). MTO technology ('methanol to olefins') competes with naphtha pyrolysis process.

Foreign companies developed such a technology of processing natural gas containing ethane, the first phase of which is gas separation resulting in the two following flows: dry gas – methane used for methanol synthesis, and then, olefins, according to MTO method; C_{2+B} fraction used for pyrolysis to get ethylene and propylene.

There are proposals concerning organization of the production of aromatic hydrocarbons from associated petroleum gas. Alongside with well-known Tsyclar and Cyclar processes, within the framework of which aromatic hydrocarbons are produced in the course of dehydrocyclization of propane-butane mix, there was suggested a technology for conversion of associated petroleum gas, first, into methanol, which, by conversion method, is converted to aromatic hydrocarbons (benzene, toluene, xylene, ethylbenzene, PNA C_{9+B}). The suggested process scheme is a comprehensive and energy-balanced one, it is fit for processing of associated gas from small and medium-sized fields being remote from trunk gas pipelines and points of gas consumption. Highly efficient technologies allowing to educe end products from C_{3+} fractions (such as Russian technology of supersonic separation of gas components) and chemical transformation of methane and ethane fractions, are being developed.

A set of technologies for hydrocarbon gases catalytic purification and processing were developed in the Catalysis Institute of the Siberian Division (SD) of the Russian Academy of Sciences (RAS), processes for converting associated petroleum gas, natural gas to chemicals and motor fuels were developed at the Institute of Petrochemicals Synthesis of RAS, Institute of Organic Chemistry of RAS, etc.

In addition to methods of processing of natural and associated petroleum gas mentioned above, much attention is now paid to methods of conversion of methane itself to chemicals not associated with the phase of producing synthetic gas, such as oxidative condensation of methane, etc.

Another line of using natural gas for producing synthetic liquid fuels and chemicals within the gas-derived chemicals industry is the synthesis of dimethyl ester (DME) through methanol. DME is an adequate substitute for diesel fuel. Moreover, DME, by ecological reasons, is used as a substitute for petroleum-derived diesel oil. Its shortcoming is deemed to be the need to establish a special DME consumption infrastructure in the transport sphere (storage, transportation, distribution) and the necessity of making certain engineering changes to the engine and automobile itself. DME is also a semi-product for producing many types of petrochemical and gas-derived industry products.

It should be noted that, in general, ROGRPGDI complex is one of the most innovation-friendly in the economy: at each process stage, at formation of some product chains, innovative technological solutions, new types of equipment are being continually developed. Economically developed countries, major transnational corporations allocate much funds to R & D and technological innovations, however, they are still eager to preserve their control over the most sensitive R & D elements and restrict their transfer to developing countries. Russia has a potential for taking an active part in these processes in respect of a number of lines of activities.

Key steps that should be taken to support the production of petrochemical products and gas-derived chemicals: methanol, its derivatives, nitrogenous fertilizers and other petrochemical and gas-derived industry products, are measures in the sphere of tariff and customs regulation. Natural gas prices for selling it to Russian producers of petrochemical products and gas-derived chemicals are several times lower than the prices for gas on the EU export market. The existing situation and pending increase of domestic gas and electrical energy prices may result in sharp growth of cost of production of feedstock semi-products of chemical synthesis, a number of gas-derived chemicals semi-products and nitrogenous fertilizers, and neutralize competitiveness of Russian producers' products. Government assistance is needed in modernization of production facilities specializing in fertilizers production, in order to cut down consumption of electric energy and the one of the natural gas itself.

3 PETROLEUM REFINING INDUSTRY

Petroleum refining sector is a set of production facilities engaged in refining and processing of oil, its fractions and petroleum gases into commercial petroleum products and raw materials in the form of semiproducts for petrochemical, basic organic synthesis and microbiological synthesis sector. The petroleum refining sector has a strategic importance for the country's economy.

Oil refining sectors' products are consumed virtually by all sectors of industry and are used in daily living and activities of all strata of the society.

Russia's overall oilstock processing capacity is 273 million tons/year; out of these:

- 28 oil refineries have the capacity of 254.4 million tons/year;
- 4 gas refining plants (mainly, processing of condensate and production of motor petrol, Diesel fuel, furnace oil): 7.8 million tons/year;
- 80 oil mini refineries: 10.8 million tons/year.

Russia's petroleum refining industry was formed in the Soviet era, during the periods when world's previous technological modes existed: 8 plants were commissioned in 1911-1944 and 6 plants – in 1945-1965. Within that period, more than half of Russia's oil refineries were commissioned. Today, the production plants built during the Soviet era, process about 98% of oil.

Some 90% of oil processing capacities are controlled by 10 vertically integrated oil and gas companies (VIOGC).

Russia ranks third in the world by the amount of primary crude oil processing, and its share in the world's oil processing is 6.3%.

The total number of world's oil refineries is consistently falling. Over the last five years, 20 oil refineries have been shut down; however, the aggregate oil refineries' capacity has grown by 4%. World's average utilization of oil refining capacities was 85.4% in 2008.

According to statistics, 493.7 million tons of oil was produced in Russia in 2009. Out of these, 235.7 million tons was refined on the domestic market, and 247.4 million tons of oil and petroleum products was exported (including 192 million tons of crude oil). Exports of Russian oil increased, despite the crisis. In 2009, output of oil in Russia increased by 1.3%, exports of oil from Russia – by 2%, volumes of oil refining fell by 0.5% compared to the previous year.

By its development level, Russia's oil refining industry severely lags behind industrially developed countries. The principal problems of the sector are: unacceptably low depth of oil processing, low quality of petroleum products produced thereby, obsolete output mix, high wear of fixed assets, high energy consumption. A distinctive feature of Russia's oil refineries is low level of oil feedstock conversion into more valuable derived products. On the average, in the Russian

Federation, yield of basic motor fuels (motor gasoline, Diesel fuel) is substantially lower than in the industrially developed countries, while the share of furnace fuel oil is the highest one.

Oil processing depth in Russia is about 71%, while in the US it ranges from 85% to 95%. On the average, in Russia, automotive gasoline yield does not exceed 18% compared to 45% in the US, and furnace fuel oil yield, on the contrary, averages 30% in Russia vs. 5% in the US.

Due to poorly developed domestic petroleum product market and low quality of exported petroleum products, Russia's oil refineries capacities' utilization is just 75%-80%, while for the global oil refining sector, due to enormous demand and high prices for petroleum products, capacity utilization close to 100% is quite typical for some countries. In the industrially developed countries, companies seek to earn on oil refining as much as possible; thus, they purchase additional amounts of oil from third parties, while Russian companies have to focus basically on crude oil export, since quality of their petroleum products does not meet stringent export standards.

Since early 2009, Russia has increased exports of petroleum products to countries outside the CIS by 7.6% year-on-year, up to 96.413 million tons.

Gasoline exports to countries outside the CIS grew in 10M 2009 by 11% and reached 2.528 million tons. Exports of Diesel fuel increased by 9.4% to 29.994 million tons, exports of furnace fuel oil grew by 6.7% to 52.412 million tons.

Meanwhile it should be noted that due to poor quality of exported petroleum products, importers from countries outside the CIS purchase them at knock-down prices: Diesel fuel – at gasoil price, burner oil – at 0.4-0.5 of crude oil price.

Exports of petroleum product to CIS countries fell during the period from January to October 2009 by 36% down to 4.3 million tons, or $1.644 bn. Gasoline exports declined by 6.7% and equalled 1.444 million tons, Diesel fuel exports decreased by 48.5% to 1.299 million tons, and furnace fuel oil exports dropped by 65% to 557 thou. tons.

3.1 IMPACT OF PETROLEUM REFINING INDUSTRY ON ENVIRONMENTAL SITUATION IN THE RF

Petroleum product production and consumption is one of Russian economy's key spheres needing the greening. Target-oriental effort in this area would make it possible to cut down drastically amounts of emissions and energy consumption, which would have a favourable effect of Russians' health, overall condition of the environment, and would improve Russian economy's stability by increasing the share of high added value products.

Government policy in the oil refining sphere has until recently encouraged Russian oil refineries to produce poor quality petroleum products.

Due to the existing specific features of taxation, the most profitable ones (with their profitability at about 30%) are the refineries performing simple distillation which produce low grade fuel, and the least profitable ones (with their profitability at just more than 10%) are the enterprises having complicated oil refining and petrochemical processes. It's worth noting that in the global oil; refining sector, the situation is quite the opposite. The existing export duty for gasoline is, on the average, two times higher than that for furnace fuel oil.

As a result, Russian-made gasoline is non-competitive on foreign markets having high paying capacity, and, in addition to crude oil, Russia is exporting to Europe, mostly Diesel fuel and furnace fuel oil. On the developed market, Russian petroleum products are subjected to secondary processing and then delivered to end consumers.

European REACH regulation having recently entered into force, has demonstrated the imperfection of the Russian system for regulation of safety of chemical products and, in particular, gasoline, compared to that of the European and the world's ones, and has shown the need to change forthwith the situation in the sphere of introduction of norms for and standardization of wares.

Federal Law on Technical Regulation and a set of technical regulations do not resolve these issues; they are just the first step towards optimization of the existing Russian legislation in order to bring it in line with the actual situation.

To ensure the greening of the Russian oil refining sector, it would be needed to use state regulation mechanisms and to launch market mechanisms for final demand greening. In their totality, these measures would create an adequate incentive for multi-billion investments in modernization of the existing and construction of new state-of-the-art oil refineries in Russia.

There are two principal objectives for the Russian oil refining industry in the sphere of ensuring environmental safety (as well as in the spheres of improving production efficiency and petroleum products use):

- **Ensuring deeper processing of oil;**
- **Producing products meeting global quality standards.**

Another strategic objective is to secure meeting petrochemical industry's growing demand for feedstock and increase exports of products for petrochemical production facilities, process for which are considerably higher than prices for basic products produced by means of oil refining.

3.2 TECHNOLOGICAL LEVEL OF THE SECTOR

Low quality of petroleum products produced in the RF is the result of obsolete process structure of the oil refining:

- share of destructive deepening processes (catalytic cracking, hydrocracking, delayed coking) is just 11.4% of the total volume of processed oil;

- share of reforming processes (catalytic reforming, hydrofining, alkylation, isomerisation, etc.) is 47.2%.

By the share of the destructive processes, Russia lags behind the US 3 times, behind the EU, on the average, 2-2.5 times, behind Japan 2.7 times, and is ahead of China 1.5 times.

Export of Russian oil refining sector consists mostly of the following petroleum products: straight-run gasoline, vacuum gas oil, Diesel fuel (having low quality compared to European requirements, as far as sulphur content is concerned), burner fuel, lube basestock. The share of high added value commercial petroleum products is low due to simple oil refining.

Oil processing depth depends on the share of secondary processes pertaining to conversion of heavy oil fractions produced in the course of the oil primary distillation.

Oil processing depth growth rates are extremely low, which undermines competitive power of the domestic products, and in foreseeable future, it would threat retargeting of sales markets and reduction of export deliveries of products produced by Russian oil refining sector.

A complicated problem of Russia's oil refining sector is high wear of its fixed assets reaching 80%, as well as its use of obsolete energy-intensive and economically imperfect technologies. As a result, this sector is characterized by high energy consumption, which affects economic efficiency of oil refining adversely. Specific consumption of energy resources at the operating Russian plants is 2-3 times higher than at their foreign peers.

As a result, the oil refining sector has acquired a number of specific features: obsolete oil refineries, low depth of oil processing, low utilization of production capacities, shortage of secondary oil processing capacities, insufficient use of modern processes.

Factors hindering technological innovations:

- Low scientific and technical potential;
- Equivocal positions of VIOGC owning oil refining facilities;
- Shortage of own funds;
- High cost of innovative solutions;
- Deficit of financial support from the Government;
- Peculiarities arising from specific features of finished product sales markets.

In this connection, to ensure production of competitive products, it would be necessary to focus principal efforts on:

- Increasing oil processing depth;
- Modernization/updating of fixed assets;
- Improving energy efficiency of enterprises of the sector;
- Introducing innovative technologies;
- Optimization of supply chains and modernization of logistical equipment;

- Strengthening of oil refining facilities' positions in forming efficient lines of VIOGC development.

3.3 GLOBAL PETROLEUM REFINING INDUSTRY DEVELOPMENT TRENDS

Basic trends in global oil refining industry development are as follows:

- Geographical changes in global production and consumption of oil refining products: setting up new production facilities in countries and regions being maximally close to growing product sales markets;

- Consolidation of Government control over oil and gas sector, predominantly, in countries producing the feedstock (Venezuela, Saudi Arabia, Russia, Malaysia, China, Iran, Brazil, etc.);

- Rapid development of downstream (refining, transportation and sales of petroleum products) in producing countries of the Near East and the Middle East, as well as South-East Asia;

- Development of alternative kinds of fuel – Europe, USA;

- Continuous growth of scientific and innovation centres role in oil refining and petrochemical sectors;

- Continuous toughening of environmental norms and laws. This toughening is related to a wide range of research of substances and materials safety, quality of products, goods circulation transportation and logistical schemes for their delivery.

Trends in the domestic oil refining sector development should be focused, as it was mentioned above, on increasing the processing depth and improving petroleum product quality. In this connection, modernization and new construction projects have been planned virtually at every domestic oil refinery.

3.4 MAJOR PROJECTS IN OIL REFINING SPHERE

According to preliminary experts' estimate, of the total quantity of process plants commissioned previously in the Russian oil refining industry, not more than 27% use Russian technologies and are equipped with Russian-made equipment. This process niche is virtually fully occupied by foreign companies. World's leading licensors and engineering companies having considerable financial potential advanced actively on the Russian market.

A number of companies plan different ways of expanding their capability to deepen the oil processing at the following facilities:

- Ryazan' Oil Refinery, TNK-BP;

- Yaroslavl Oil Refinery, Slavneft OJSC;

- Nizhnekamsk Oil Refinery, TAIF-NK OJSC;

- Kirishenefteorgsintez, Surgutneftegaz OJSC.

However, some of the announced projects are severely decelerated by the companies, and one of the reasons for that is shortage of funds for their implementation, and another reason is the lack of motivated desire to implement them.

Hydrofining processes account for the largest share of the process. Existence of a large amount of hydrofining capacities stems from the need to use this technology for the production of motor fuels, the quality of which meets modern standards. In addition, isomerization and alkylation processes should necessarily be used in oil refining process flow schemes in order to ensure requisite quality of high-octane gasolines.

According to expert estimates, to achieve all this, it would be required to launch, in Russia, manufacture of relevant equipment in quantities covering at least 75% of the projected need in such equipment.

Some of the projects being currently implemented could be called strategic ones. These are: construction of TANEKO Complex in Nizhnekamsk, expansion of Tuapse Oil Refinery capacity and construction of a new Oil Refinery at Koz'mino Bay. The extent to which Russian equipment is used in these projects, would largely determine future lines of development of both oil refining facilities and Russia's oil industry in general.

Manufacturers of large reactor equipment could potentially become suppliers of necessary equipment in the RF, although there is a great number of relatively small enterprises in the RF operating on medium-scale equipment market.

The existing machine building complex manufacturing equipment for the oil refining sector should be developed, the RF equipment market should be expanded, and it would be necessary to enter the global markets. Although currently the RF lags behind in technologies and engineering, its production facilities are quite competitive. Thus, for further advances it would be necessary to combine efforts of oil refiners and machine builders. Coordination of oil refining industry and engineering industry development should be ensured, and it would be needed to create more stable environment for the equipment manufacture in order to carry out successful modernization and renewal of the equipment, as well as to secure skilled staff training. It could be achieved by comprehensive planning of manufacture and starting, actually, serial production of engineering products.

This objective is quite achievable, and to achieve it, just a focused desire to do so on the part of top managers of companies and processing facilities, as well as wide-scale support by commanding elite and government authorities would be necessary.

3.5 SMALL ENTERPRISES IN OIL REFINING SECTOR

Small-scale oil refining sector started to be formed in Russia after the collapse of the USSR. Today, the majority of oil mini-refineries, as far as their process is concerned, are atmospheric distillation plants designed on the basis of simplified schemes. This refers to legally operating plants, rather than about so-called "teapot refineries", for which no official statistical data exist.

Analysis of breakdown of operating oil mini-refineries by Federal Supra-Region reveals the concentration of small-scale refining in the areas where large-scale refining is insufficient or does not exist at all. For instance, in Volga Federal Supra-Region, there is located almost a half of large refineries and less than a quarter of oil mini-refineries, or 12 and 19 enterprises, respectively. At the same time, there are no large refineries at all; however, 13 mini-refineries are operating there officially.

At many oil mini-refineries, the extent of automation of the oil straight-run distillation process is not high enough. Due to small unit capacities, it would be inexpedient to introduce secondary processes in order to deepen the oil processing, as well as to improve quality of petroleum products produced as a result of feedstock processing.

At the same time, almost at ¾ of oil mini-refineries being currently constructed, would have engineering capabilities for the production of high-octane grades of gasoline or high quality Diesel fuel.

Moreover, yet another option for the efficient use of oil mini-refineries is possible. They could be used for processing of such grades of oil which do not require using additional technologies for ensuring the needed quality (for the production of Diesel fuel and some sorts of jet kerosene).

In any other case, products of oil mini-refineries (straight-run gasoline, Diesel fuel and furnace fuel oil) have long ago established their positions on petroleum product export markets.

Thus, the Russian small-scale oil refining sector is just a local phenomenon, the role of which as a method for creating additional competition on the motor fuel market across the country is severely exaggerated. Oil mini-refineries, in the form in which they currently exist, indeed may have an impact on motor fuel markets at certain remote regions of Russia having small population and fuel consumption. However, it would be the result of low prices for petroleum products, rather than their quality. Fully-fledged competition on the part of oil mini-refineries would only be possible in the event of growth of their contribution to petroleum product output, which seems absolutely unlikely.

To encourage revamping of the domestic oil refining industry, the following measures would be needed:

- Setting equal export duties for light and dark petroleum products – it would be an expedient measure.

- On the background of increased differentiation of taxing of oil production and export (and, thus, decrease of total budgetary incomings), a certain increase of total burden (primarily, an export-related one) on petroleum products would be possible. However, such an increase should not be sharp, and it should be carefully calculated in advance.

- Role of the Government would be to understand interrelatedness of all types of imposed duties and payments, as well as of the fact that collection of requisite total amount of proceeds from taxes and levies would only be achieved in the event of setting a rational structure of all types of duties and payments (for oil and petroleum products for export deliveries, and on the domestic market).

Let's now turn to those sectors of oil and gas processing complex which are bound to make the maximum contribution to ensuring sharp increase of this complex contribution to growth of the economy and its qualitative transformation.

4. LIQUIFIED PETROLEUM GAS (LPG) MARKET

LPG market comprises the following products: PBT (commercial propane-butane), commercial butane (BT), butane for vehicles (PA), propane-butane for vehicles (PBA), commercial propane (PT, grades A and B), normal butane (grades A and B), isobutane (grades A and B), propane-propylene fraction (PPF), butane-butylene fraction (BBF), butylene-butadiene fraction, isobutene-isobutylene fraction.

Output. In 2009, 11.051 million tons of liquefied gases were produced in the RF, which is 10% higher than in 2008 and almost two-times higher than eight years ago (see Table 5).

Table 5. Output Dynamics in 2002-2009, thou. tons/year

2002	2003	2004	2005	2006	2007	2008	2009
5,908	6,883	7,327	8,033	9,218.3	10,856.3	10,038.5	11,051

Source: Academy for Industrial Markets Conditions.

In 2009, the share of sector's leader, SIBUR, in Russia's overall liquefied petroleum gases production was 30% (or 3.35 million tons), which was 7% more than a year before. Gazprom enterprises ranked second in the LPG output (2.028 million tons), and their production of LPG increased by 1% during the same period. NOVATEK increased its output by 22% compared to 2008 (up to 760.1 thou. tons).

Spheres of Russian-produced LPG use are as follows:

- use as a chemical raw material: 34.0%;
- use in communal & household sector: 15.4%;
- exports: 28.4%;
- use as a motor fuel: 22.2%;

(InfoTEK-CONSULT data for the first 4 months of 2010).

Exports. Table 6 shows exports growth dynamics in absolute terms, as well as growth of LPG exports share. It should be noted that due to the crisis, in 2009, deliveries to the domestic market for gas-derived chemicals and petrochemical industry dropped, and in this connection, additional amounts of LPG were exported. 3.8 million tons of LPG were sold on the external market (see Table 6). **It was facilitated by measures aimed at setting customs duties for liquefied gases to zero, as well as by introduction of new exclusive railway tariffs factors (KIT).** Indeed, one of significant measures aimed at securing competitiveness and necessary volumes of LPG sales on export markets was the Government's decision to abolish temporarily the export duty for LPG. Before the crisis, the duty for liquefied petroleum gas was calculated by the same formula as the export duty for petroleum products (gasoline, Diesel fuel), i.e., it depended upon export duty for oil. According to SIBUR data, in November 2008, the value of one ton of LPG was $477, out of this

amount, $206 was the duty (in case of transportation in tank cars - $240), while the cost price was $130. As a result, net loss per 1 ton of LPG equalled $99. In December 2008 – January 2009, the situation even worsened for the exporters, since LPG export prices fell even further.

The Government decided to set the duties to zero in order to support Novatek, SIBUR and Gazprom. At the current stage, the duty was introduced once again, but it was calculated on the basis of different criteria (such as LPG quotations in Eastern Europe), rather than petroleum product basket. Such measure enabled Russian producers to compete successively with other suppliers on the European market (with LPG coming from Kazakhstan and Norway) and to achieve high profitability of LPG export.

Today, opposite trends emerged. Pursuant to the RF Government Resolution, the amount of duty for LPG should be doubled in November 2010 and reach $116.4 per ton, and from December 1, 2010, according to the RF Government Resolution No.930 dated November 27, 2010, the duty should reach as much as $118.1. These trends result from the need to support the domestic market and liquidate LPG shortage on retail markets. However, we do not understand why the same duty applies to LPG being the feedstock for gas-derived chemicals industry, such as butanes, ethylene, propylene, butylenes and butadiene, as well as other liquefied gases.

Table 6. Balance of LPG Production and Consumption in the RF in 2004-2009, thou. tons/year

Item	2004	2005	2006	2007	2008	2009
Production	7,327	8,033	9,218.3	10,856	10,039	11,051
Exports	1,158	1,103	1,138	1,478	1,952	3,767
Imports	93	63	11	140	184	75
Consumption	6,262	6,993	8,091	9,518	8,271	7,359
Share of exports in the production	15.8	13.7	9.9	13.6	19.4	34.1
Share of imports in the consumption	1.5	0.9	0.1	1.5	2.2	1.0

Source: Academy for Industrial Markets Conditions.

However, there are serious problems, primarily, **logistical limitations**, hampering LPG export development. The main areas of export are Poland, Turkey, Finland, Belarus, Hungary. Entry of the Russian products to far-away markets is currently hindered by lack of companies' own sea terminals capable of accepting heavy-tonnage vessels. The principal solution to this problem is to develop relevant infrastructure, *inter alia*, using government financing. As sea terminals develop, Russian exporters would be able to enter larger and more promising sales markets. The major LPG

consumers are countries having well-developed gas-derived chemicals and petrochemical industry. These are the US, developed EU countries. In future, significant growth of LPG deliveries to markets of Asia-Pacific Region, Eastern Europe would be possible. High growth rates of LPG consumption are demonstrated by Asian countries (China, Japan).

Imports. LPG imports share in total Russia's consumption reached their 5-years' maximum in 2008 and equalled 184 thou. tons. However, in 2009, they dropped sharply to estimated 75 thou. tons. In future, the imports could remain insignificant due to growth of LPG domestic production. However, as export terminals are developed, Russia could become a transit territory for LPG produced in CIS countries.

Domestic consumption. Capacity of the liquefied petroleum gases in 2009 was equal, in physical figures, to 7,359 thou. tons. Despite the general decline in LPG consumption on the domestic market in 2006-2009, the year 2009 demonstrated growth vs. 2004-2005, which means that an unrealized LPG consumption potential on the domestic market does exist.

One of the basic factors restricting growth of LPG consumption on retail markets is a monopolistic, unliberal nature of these markets.

To liberalize the LPG retail markets, it would be necessary to transfer from government regulation of prices for household LPG to market pricing mechanism, to introduce a mechanism for price-related competition between LPG producers, to provide regional participants of the market with an opportunity for guaranteed storage of LPG at LPG filling stations. Introduction of all these mechanisms should be carried out concurrently with the introduction of the mechanism for quality control for liquefied gases sold on retail markets.

Setting up of a federal exchange LPG trading marketplace with remote regional terminals would help to resolve the issue of ensuring uninterrupted liquefied petroleum gas (LPG) for motor transport, industry, small-scale power generating sector and the public, by substituting government regulation of prices for household LPG with the market mechanism for management of LPG pricing.

For setting up a mechanism ensuring government influence on LPG prices at retail markets, it would be expedient to create a system of peak-shavings[1] and, accordingly, a state reserve of LPG, by means of which it would be possible to manage seasonal fluctuations of LPG prices. It would be necessary to establish an LPG quality control mechanism within the framework of the exchange trading marketplace. The system of peak-shavings could be set up as a state-run enterprise within the RF State Committee for Reserves (Rosrezerv), with the Government financing of the creation of such LPG storage infrastructure.

[1] Peak shaving means the process of stocking a resource on the moment of its low consumption in order to use the stock on the moment of peak loads; initially, this term was used in electric power generation industry, and then it got to be used in LPG context; we found it appropriate to use this term in the LPG context where it means a cluster base for separate storage at any moment of more than 10 thou. tons of LPG.

In the coming years, one can expect further significant growth of LPG production as the programme for sharp increase of APG resources utilization is implemented. Statistical data on APG combustion/flaring volumes is controversial, and, accordingly, there exists a certain range for the potential growth of its processing and producing conversion products, first of all LPG and stable gas condensate. It may secure additional production volumes – roughly 5-7 million tons of LPG per year and 1.5-2 million tons of condensate per year.

In the medium term, natural gas production would be accompanied by increase of produced gas condensate share. In would be, primarily, the result of shifting to the development of deeper Valanzhinsky and Achimovsky horizons containing predominantly the gas saturated with condensate. Growth of gas condensate production volumes would be mostly achieved due to largest gas producing companies, such as GAZPROM OJSC and NOVATEK OJSC. According to various estimates, an additional potential for LPG production in Western Siberia and at new fields in Eastern Siberia could reach 10-15 million tons as early as 2020, and the total potential for the condensate production could come close to 30 million tons per year, which is much larger than the LPG and condensate volumes extracted from APG.

Without creating an infrastructure (at the initial stage) for transportation to export markets and capacities for LPG processing (in the process of building up capacities for converting light hydrocarbons into feedstock for gas-derived chemicals and petrochemical industry) in Russia, additional volumes of the LPG could remain non-demanded.

As it was told above, Russia's most important and promising LPG consumption sectors are using the LPG as a feedstock for chemical industry, as well as for household needs and motor transport.

Table 7. Consumption of LPG as a Feedstock for Chemical Industry, thou. tons/year

Line of consumption	Actual figures		Predicted figures	
	2000	2005	2010	2020
For dehydrogenation	812	1,475	1,815	1,920
For pyrolysis	2,014	2,200	2,600	2,800
Total:	2,826	3,675	4,415	4,720

Source: InfoTEK Monthly Oil and Gas Journal, No.5, 2010.

It follows from Table 7 that an insignificant increase in LPG consumption is expected over 2010-2020. The most significant projects being implemented in this sphere are: propane dehydrogenating plant producing propylene and polypropylene having the capacity of 400-450 thou.

tons per year, and NGL pyrolysis plant producing 400-500 thou. tons of ethylene and polyethylene per year and 300-400 thou. tons of propylene and polypropylene per year. Both plants will be constructed at Tobolsk Petrochemical Facility being a part of SIBUR Holding OJSC.

Such an insignificant growth of LPG consumption by the petrochemical industry apparently reflects an inertial scenario for petrochemical and gas-derived chemicals (PGDC) industry development, and this figure seems to be absolutely insufficient and not matching actual resource-related opportunities.

This, on the whole, we view the following dynamics of LPG production and markets in Russia:

- Setting up of a self-regulating organisation as a mechanism providing access to exchange auctions where trading in LPG is carried out; as a mechanism for control of quality of products traded at such exchange;
- Consistent and rather quick building up of LPG resources, with bringing them from current 10-11 million tons/year to the level of 30-50 million tons/year;
- Moderate growth of LPG use in gas-derived chemicals industry and PGDC industry in the near term and forming additional resources for export and for increasing the scale of use of LPG as a motor fuel in the longer term;
- Growth of LPG consumption for household needs in small towns and remote areas (substitution of coal, firewood, Diesel fuel and, possibly, natural gas);
- In medium- and long-term, an opportunity to use the growing LPG resources as the basis for a large-scale growth of the entire oil and gas processing industry.

It should be mentioned also that the development of the gas processing sphere would result in significant growth of resources of another valuable feedstock – ethane. Even now, some 0.5 million tons of ethane per year is not extracted and is combusted or flared as APG, and at least 2.0 million tons of ethane per year is not extracted from the gas flow supplied by means of gas pipelines. Potential resources of ethane are estimated at 10-15 million tons per year; out of these, 4-5 million tons of ethane per year could be extracted from ethane-rich natural gas produced at Nadym-Pur-Taz Region deposits (Valanzhinsky and Achimovsky horizons) and used for the production of petroleum and gas-derived chemicals. Ethane is widely used as a feedstock for the production of ethylene – a product of the PGDC industry produced on the largest scale. It would have been an inexcusable economic mismanagement and wastefulness to miss opportunities related to such resources use. In particular, every year, 16 million tons of ethane is used in the US, 20 million tons – in Saudi Arabia, while in the RF, just 0.4 million tons of ethane is used every year.

We would also like to note that the forthcoming multi-fold growth of condensate production would create favourable conditions for developing such sectors of PGDC industry which are still

based on use of oil stock (naphtha), resources of which would fall due to modernization of the oil processing sector, as well as favourable conditions for export.

In order to ensure development of the domestic LPG sales market, and it is a priority task, it would be necessary to provide economic encouragement for the development of LPG retail sales infrastructure, namely:

1. Providing tax incentives for (incentivization of) the creation of new LPG sales facilities: LPG filling points, cluster-type tank units, LPG filling station for motor vehicles; encouraging the creation of LPG facilities ensuring safe functioning of the entire infrastructure: gas cylinder exchange and inspection points, laboratories for control of LPG resources quality: household LPG, LPG for motor transport;
2. Encouragement of construction of LPG separate storage bases (to ensure product quality); introducing penal sanctions for using improper LPG;
3. Encouragement of construction of shops for conversion of automobiles to LPG;
4. Encouragement of investments and innovations in this sphere, which may even include provision of grants for introducing advanced technologies (for instance introduction of a new gas cylinder design in the RF);
5. Entering sections pertaining to the development of LPG market for communal & household consumption, to regional and federal programmes for the development of HUS;
6. Creating a separate Federal Programme for the Development of gas-engine fuel market in the RF.

For the same purposes, it would be needed to encourage consumers to switch from gasoline to LPG being more environmentally-friendly motor fuel, for instance, by introducing partial subsidizing for automobile owners who install compressed gas equipment on their vehicles.

4.1 ENVIRONMENTAL ASPECTS OF SWITCHING MOTOR TRANSPORT TO GAS ENGINE FUEL

In the Russian Federation, the share of motor transport in overall emissions of contaminants from any sources to the atmosphere reaches 45%, which is higher than any industry sector's share. In recent years, the motor transport has been one of the main sources of emission of harmful substances contaminating atmospheric air of cities and towns. In some cities, the motor transport's share in pollution of the atmosphere reached 50%-90% (Moscow: 93.7%, Yekaterinburg: 70%. Omsk: 56%). Use of LPG (propane-butane) as a motor fuel would make it possible to improve environmental performance of the motor transport, which would be especially important for large

cities. Table 8 below shows actual environmental efficiency of switching particular models of Russian-made vehicles to gas fuel.

Table 8. Comparative Environmental Performance of Vehicles Using Gasoline and Propane-Butane. Comparison of harmful emission volumes.

		Vehicle Model					
		VAZ 2106-10	GAZ 31029	Moskvich 412	GAZ 33022	GAZ-53	ZIL-130
Fuel consumption (l/100 km)	Gasoline	10.3	14.95	11.5	19	29	47
	Gas	9	13	10	16.5	25	41
CO emission, %	Gasoline	0.3	0.3	0.3	0.4	1	1
	Gas	0.1	0.2	0.1	0.2	0.4	0.4

5. THE ISSUE OF, AND PROSPECTS FOR ASSOCIATED PETROLEUM GAS (APG) UTILIZATION

Low level of utilization of APG and UGC is one of the most acute current problems associated with the development of Russia's oil and gas sector. In recent years, Russia has ranked first in the world by the volumes of APG being flared. According to various statistical data and estimates, every year, up to 55-60 bn m^3 of APG is extracted in Russia. Out of this amount, some 15-25 bn m^3 (according to other expert estimates, 30-40 bn m^3) of APG is flared.

Associated petroleum gas is a strategically important resource of the country's petrochemical industry, largely determining Russia's economic and industrial potential. **The reasons for flaring APG in Russia are largely determined by peculiar features of the historical environment in which the oil and gas sector has been developing. APG utilization is a complicated systemic problem, and to resolve it, coordinated efforts on the part of all the parties being concerned (the state, oil companies, Gazprom and SIBUR) would be required. The joint actions should be based on accommodation of the aforesaid parties' interests, which, in its turn, would be necessary due to inconsistency of interests and contradictory suggested approaches to the problem. It would be also needed to involve small and medium-sized businesses in resolving this problem. These businesses, together with Gazprom and Sibur, should become driving forces for the APG utilization.**

In Russia and abroad, utilization of APG means using the APG resources by the following three basic methods:

1) collection and refinement of APG and UGC at gas refining plants (GRP), extraction of LPG, SNG and DSG (some production facilities produce NGL and DSG only), as well as processing of APG and UGC directly at oil and gas production facilities. Modern technologies and equipment make it possible to develop both large-scale gas refining facilities (having throughput of several billion cub. m each), and medium-scale and small plants located directly at oil and gas production facilities;

2) using APG directly in the production areas for process needs and generating electric power (both for producing assets' own needs and for sale). Use of APG as a feedstock for generating electric power sold to external consumers would be feasible in the event of unprofitability of introducing gas separation at a relevant oil and gas producing asset;

3) pumping of the gas into productive oil formations in order to increase oil recovery, maintain formation pressure, preserve gas resources and prevent gas flaring.

The third of the utilization methods set out above is used more frequently in cases where capabilities of the first two ones are limited, for example, in a shelf area. In other words, it is used when utilization of gas by other methods is physically impossible or economically unfeasible.

Restrictions of the 3-rd option are also related to limitations of process and economic nature. For instance, pumping of gas into formation results in changes of their properties and, accordingly, requirements to operating modes and equipment become varying in time. A sort of gas resources conservation may turn into a special form of APG losses as oil reserves become depleted. It follows from it that a situation could occur when from two expected positive effects (economic and environmental ones), just one – environmental effect – would actually be obtained.

In the RF, an insufficient attention is paid to the issues relating to gas pumping into formations, and all the attention is focused on the issue of gas processing, although there actually are few instances when APG is used efficiently for improving oil recovery from formations.

The second option has both its advantages and limitations as to APG utilization. On the one hand, its advantage is its relatively good cost effectiveness (there is no need to construct the entire range of facilities for gas collection, transportation, processing, as well as to connect to the GTS and NGL transportation systems). On the other hand, the limitations pertaining to implementation of the 2-nd option result from limited demand for energy resources and, primarily, electric power in oil producing areas, as well as from process- and regulation-related problems with deliveries of electric power generated at facilities independent from the electric power supply system. In addition, in case where under the 2-nd option, no heavy components are recovered in advance (i.e., when no processing of APG is carried out), then, from environmental point of view, this method does not differ much from mere flaring of APG: emissions of heavy component combustion products containing noxious substances to the atmosphere would hardly decrease.

Therefore, it is the first method (including comprehensive processing and use of APG resources, and being used on its own or as a component of methods 1 or 3), which should become a priority line for APG utilization. Only in cases where due to remote location, small amount of resources, or lack of necessary infrastructure, its implementation is either impossible or inefficient, one can agree to abandon processing of APG resources.

To resolve the APG utilization problem, it would be necessary to:

- ensure priority and long-term access of DSG resources to the capacities of the Unified Gas Supply System;
- facilitate formation of regional infrastructural projects relating to transportation of DSG, APG and NGL (UGC) resources produced by different business entities;
- facilitate opening of APG resources for their processing by medium-sized businesses;
- form a civilized domestic LPG market – both in wholesale sphere and in the sphere of deliveries to retail markets and petrochemical & gas-derived chemicals enterprises.

In his report as of October 28, 2010, regarding the General Scheme for Oil Sector Development for the Period of up to 2020 (see Fig. 7), Minister of Energy Mr. S.I. Shmatko stated

only that currently 76% of gas was utilized and 24% - flared; it is projected for 2020 to utilize as much as 95% of APG. Out of the total APG volume, 55% would be supplied to the UGSS, 13% would be used for electric power generation, 8% would be pumped back to formations, and the remaining 19% would be processed (apparently, the figure reflects an averaged amount of gasified derivatives).

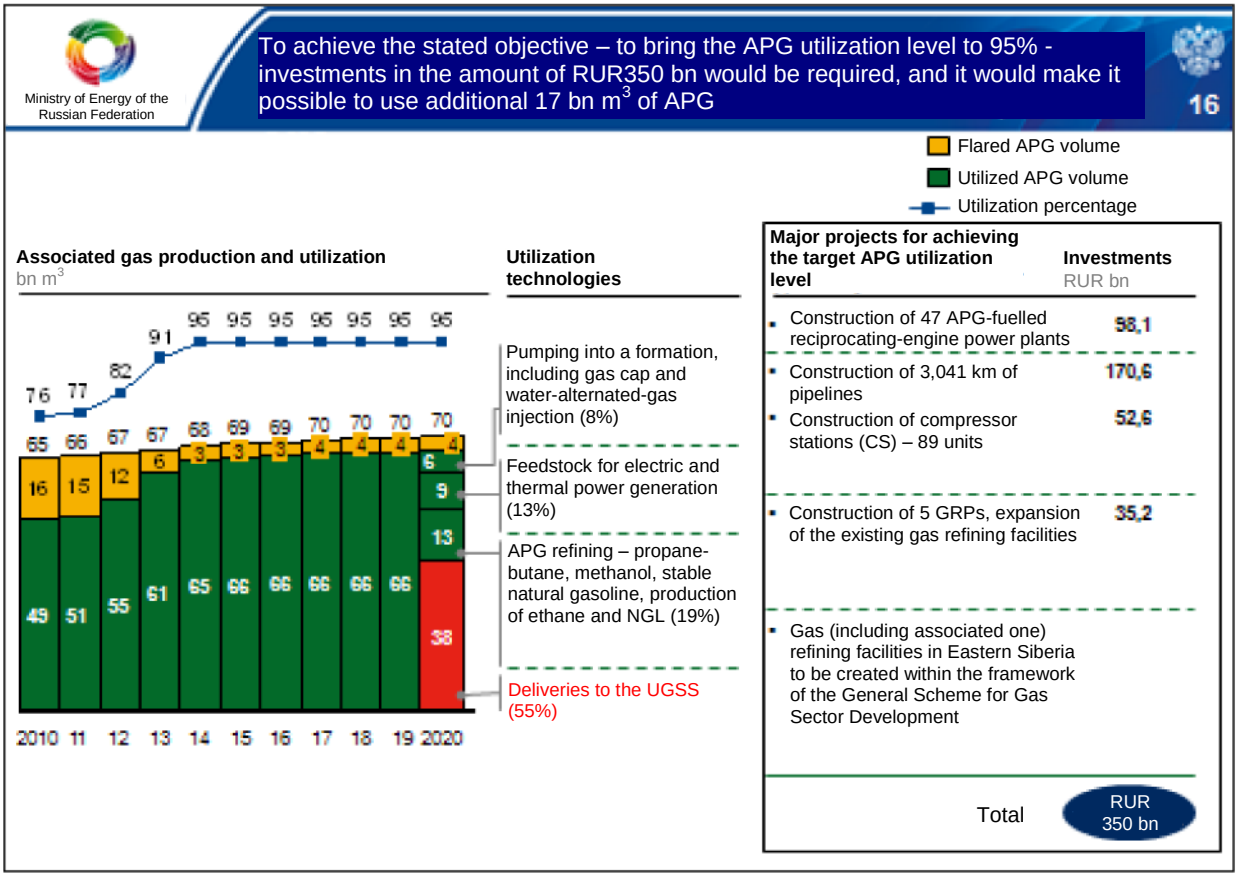

Fig.7. Predicted Shares of APG Utilization Methods

Thus, holding the government in distrust, oil companies predominantly focus on the utilization methods being most accessible to them.

It seems that interests of major participants of the utilization process could be balanced as follows:

THE STATE:

The state should use a *comprehensive approach* which should include:

- applying coercive measures to oil and gas companies in order to bring the APG utilization level up to 95% by 2012;
- defining precisely the criteria for APG use efficiency and stimulating the use of the most efficient utilization option for a particular oil and gas field;

- general inclusion (most likely, retroactively) in licenses for the right to use subsurface mineral resources – extraction of an oil and gas resource – being and having been issued and of APG, of a provision stipulating that at least 95% of extracted APG should be utilized;
- applying economic encouragement measures (including provision of tax incentives) in respect of APG and UGC utilization;
- elaboration and application of a system of guarantees for small and medium-sized businesses in respect of access to APG and UGC resources belonging to oil and gas monopolies and ensuring such monopolies' performance of APG and UGC resources purchase-and-sale agreements concluded with small and medium-sized businesses. For this purpose, it would be necessary for the RF Government to adopt a resolution pertaining to coordination and launching of relevant government guarantees mechanism. Such a system of guarantees could be implemented by setting up a Federal Marketplace for sale of APG to independent investors;
- support to introduction of innovative solutions in the sphere of APG and UGC utilization (advanced solutions in the spheres of gas refining, pumping gas into formation, GTL technologies).

OIL COMPANIES:

In many cases, having no direct interest in APG utilization, as well as in resolving environmental problems, given that gas utilization would bring profit and reduce the amount of penal sanctions, the scale of which from 2012 would have a material impact on the efficiency of companies' business, the oil companies would facilitate large processing companies' investment efforts in preparation and implementation of APG utilization projects.

The oil companies are actively developing their gas refining capacities and retail networks engaged in sales of final products. For example, Lukoil Oil Company is currently producing as much as 1 million tons of LPG per year, and it plans to increase the refining volume, all the more so, as the oil companies already have the resource needed for that. Today, TNK-BP is developing the gas refining in Orenburg Oblast, increasing the capacity of Zaikinsky Gas Refining Enterprise and having created a GRP; Rosneft Oil Company has constructed its Slavyansky GRP, and a GRP was constructed in Saratov Oblast.

GAZPROM:

In the situation where utilization of its Gas Transportation System (GTS) is somewhat decreasing, Gazprom could differentiate its approaches to provision of access thereto for DSG

resources (quantity of which is relatively small) compared to resources of major new projects for natural gas deliveries by independent producers which either require creating new transportation capacities, or synchronization of relevant inputs of gas with Gazprom's own plans. Ensuring a priority access for DSG resources to its GTS as early as in the coming years, till 2016, when deliveries from its traditional producing areas are expected to fall and relevant capacities would be released, Gazprom should not reduce its requirements to DSG pre-transportation treatment quality, thus stimulating high-quality processing of APG.

SIBUR:

One of the major challenges concerning implementation of SIBUR plans is to ensure deliveries of APG to its facilities, since the existing GRPs are located mostly at old producing areas of Western Siberia. It would be expedient if the government renders its assistance in overcoming such infrastructural limitations (in cases where it is economically feasible) at the phase when sharp growth of volume of the resources for processing is expected. It would be also important to determine the prospects for coordinating SIBUR's plans for APG resources processing and oil companies' plans for APG utilization, including the construction of their own gas refining facilities and MPPs.

We would like to focus your attention on the following two important proposals aimed at improving the efficiency of APG use:

first, the state should participate in building infrastructure of oil and gas fields supplying feedstock for the projects for APG and UGC utilization, including participation through federal and regional programmes;

second, small and medium-sized businesses (such as investment and specialized managing service companies) should become involved in resolving the APG utilization issue, in case where such sphere of activities would be an important, rather than casual or burdensome one for such businesses, and where such companies would be capable of implementing such projects quickly and efficiently, without using subsurface resources users' funds.

We would also like to note an innovative method of gas utilization – its processing by means of GTL technology. On the one hand, it would resolve an issue of associated petroleum gas processing, and penalties for flaring it would not be applied. In such a case, it would be unnecessary to build a pipeline linking a well and a processing point, i.e., synthetic crude oil produced by means of GTL technology can be pumped into an oil pipeline together with the bulk of produced oil, while petrol produced by the same technology can be taken away by motor transport, provided that automobile roads are available. Moreover, the issue if dry gas transportation, which in some cases becomes the most acute one, no longer exists. There currently exist pilot units of module-based

GTL plants making it possible to utilize APG extracted from fields containing medium-sized or small oil reserves. The principal economic effect can be achieved by saving on penal sanctions imposed for APG flaring and saving on capital expenditures, since it is no longer needed to construct additional gas pipelines.

An additional promising line of APG processing is creation of a low-tonnage technology for conversion of hydrocarbons to methanol designed for being used directly at gas and oil production areas. Creation of low-tonnage gas-derived chemicals production facilities using associated gas or low pressure natural gas delivered from producer's own sources of feedstock would make it possible to cover local needs in methanol.

5.1 ENVIRONMENTAL ASPECTS OF ASSOCIATED PETROLEUM GAS COMBUSTION

Every year, as a result of APG flaring, more than half a million of contaminants, such as carbon dioxide, sulphur dioxide and soot particles, products of incomplete combustion of hydrocarbons, carbon monoxide, sulphur dioxide and nitrogen oxides, are emitted to the atmosphere in Russia. The share of emissions formed as a result of APG flaring is 30% of total emissions to the atmosphere in Western Siberia and 12% of Russia fixed sources emissions.

Three principal lines of APG utilization were mentioned above. APG processing with extraction of the maximum of fractions is often the most efficient way of its beneficial use and of resolving environmental problems.

From an environmental viewpoint, burning of associated petroleum gas in power generating units does not differ in any way from APG flaring. However, there are other differences. The first one is that satellites do not detect burning of APG in power generators. The second difference is that the issue is not regulated by any legal documents. In addition, at field-based gas turbine and gas-fuelled reciprocating-engine power plants, in general, it is not the dry stripped gas consisting predominantly of methane which is normally burnt there, but the gases of the first and second separation stages (C_{2+B}) upon combustion of which, contrary to methane, large amounts of noxious substances are emitted to the atmosphere. In opinion of many civil servants, experts and specialists tackling utilization problems, APG burning in power generating units is just the same serious waste of resources as the use of flares destroying valuable resources which could otherwise be used as feedstock for gas-derived chemicals and petrochemical industries.

Unfortunately, since there haven't been taken any measures aimed at encouraging comprehensive use of APG resources, and in the situation where the share of small and medium-sized remote fields would grow in future, the share of power generators installed at small and

medium-sized remote fields and pipelines in overall volumes of APG processing would grow, which would not resolve the environmental problem.

One of the tasks of the RF Government is to provide state support for resolving environmental problems, *inter alia*, to ensure volumes of APG flaring. Having signed the Kyoto Protocol, the Russian Government provided the business with an opportunity to use its implementation mechanisms for attracting carbon-related financing to projects aimed at reducing harmful emissions. Some of the most notable projects in this sphere are the projects aimed at reducing APG flaring volumes. Out of the first 15 projects to be implemented within the framework of the Kyoto Protocol implementation, the Ministry for Economic Development approved 6 projects in the sphere of APG utilization.

Summing up the aforesaid, the following dynamics of OGRRPGDCI development could be predicted:

- in the coming years, the issue of APG resources utilization would be settled, which, in the event of concentrating efforts on efficient methods of such resources use should result in significant growth of LPG and condensate production, which, alongside with increase of exports and LPG household consumption would make it possible to launch PGDC industries development process based on gas resources;
- concurrently, implementation of projects aimed at oil refining facilities modernization, with the aim to satisfy the domestic market demand for high quality fuel, sharp reduction of production and exports of black oil fuel and low quality kinds of fuel;
- gradual implementation of investment projects for deeper processing of resources of gas rich in higher hydrocarbons and PGDC industries, accompanied by expansion of volumes and range of products, which would transform Russia into one of the global centres of the world's OGRRPGDCI.

Indeed, in order to ensure such direction of the development, formulation and implementation of a wide range of measures aimed at supporting it would be necessary.

6 OGRRPGDCI INFRASTRUCTURE AND ITS DEVELOPMENT

Infrastructure development is a powerful growth driver for the country's economy in general. Ensuring efficiency of gas processing and gas-derived chemicals industry would only be possible in case of systemic approach to the sector development, a component of which is the infrastructure construction.

There are several key issues among major problems relating to the development of infrastructure for hydrocarbon raw materials transportation and sale:

1) underdeveloped infrastructure for collection, treatment and transportation of APG;

2) the issue of access to the Unified Gas Transportation Network for DSG sale;

3) general problems associated with LPG retail infrastructure, in particular, underdeveloped LPG filling stations infrastructure.

Now, let's discuss these issues in brief.

6.1 ISSUES RELATING TO APG COLLECTION, TREATMENT, TRANSPORTATION AND REFINING INFRASTRUCTURE DEVELOPMENT, AND PROBLEMS RELATING TO DSG ACCESS TO THE UNIFIED GAS TRANSPORTATION NETWORK

During the Soviet era, the infrastructure for collection and delivery of APG to gas refining plants was being developed within the framework of the centralized planned economy. Financing was provided under a single programme for fields development. Upon USSR collapse, several independent oil companies were formed in the course of economic reforms. At the same time, the infrastructure for collection and delivery of APG to GRP remained to be owned by gas processing companies. Thus, the gas sources were controlled by oil producers, while the APG collection and processing system was controlled by gas processing companies. In today's Russia, the degree of APG utilization is low due to lack of coordination between oil companies' and gas processing companies' operations, as well as because of lack of the infrastructure for collection, transportation and processing of hydrocarbons.

At the current stage, there also exists a problem relating to expansion of gas refining plants capacities and their utilization. For instance, restrictions for expanding processing volumes at Belozyorny GRP and Nizhnevartovsky GRIP result from limited capability to sell DSG to Parabel'-Kuzbass "methane" gas pipeline. In this connection, Sibur and Gazprom are implementing a programme for the expansion and upgrading of DSG acceptance facilities. Gas services are installed in residential and industrial areas in order to ensure subsequent DSG sales.

Yet another problem is the limited infrastructure for sale of additional NGL volumes from Pyt'-Yakh Station load rack and then by pipeline to Tobolsk. To resolve this issue, Sibur

implements its investment projects aimed at expanding NGL and DSG transportation infrastructure, as well as expanding CGFP in Tobolsk to perform fractional distillation of additional amounts of NGL and their further processing within the framework of gas-derived chemicals sector.

Projects for the construction of product pipelines carrying C_{2+B} fraction (produced by its separation from natural gas extracted at Nadym-Pur-Taz Area fields) from Urengoi to Vyborg, as well as a product pipeline carrying NGL along Ust-Balyk-Tobolsk-Nizhnekamsk-Ufa route (with re-building of a destroyed product pipeline at Tobolsk-Nizhnekamsk section) are being currently discussed.

Thus, to increase the APG processing volumes, it would be necessary to establish a coordinated economic policy on the part of oil production and gas refining enterprises, as well as Gazprom OJSC, in the sphere of setting up a collection, transportation, processing and sales (acceptance of DSG and NGL) infrastructure.

6.2 GENERAL PROBLEMS RELATING TO LPG INFRASTRUCTURE DEVELOPMENT

Today, about 30% of exported LPG is transhipped through sea terminals. In Russia, most of liquefied gas is transported by rail transport. Russia has just one sea terminal engaged in LPG transhipment. It is located at the Temryuk Port, and it is capable to accept vessels of shallow draught only. But small deadweight vessels have a limited operating range and, accordingly, they can serve just a limited sales area. Small shipment volumes make long-range transportation unprofitable, and it may be the reason for an insignificant radius at which the sales areas are located: LPG is exported from the Temryuk Port to Turkey, Bulgaria, Romania. The need to seek new LPG sales channels resulted in developing an LPG transhipment complex project at Ust-Luga being currently implemented by Sibur-Holding OJSC. Taman'neftegaz CJSC, being a subsidiary of OTEKO transport holding, intends to construct another export terminal for liquefied hydrocarbons at the Taman' Port.

6.3 INSUFFICIENT DEVELOPMENT OF RETAIL LPG MARKET INFRASTRUCTURE, INCLUDING THAT OF LPG/LNG FILLING STATIONS

LPG market infrastructure in the RF includes 47 major producing plants, 3 small gas refining plants, more than 300 LPG filling stations, over 3300 LPG filling stations for motor vehicles, and a certain number of gas modules at multifuel filling stations (MFFS). There are about 1 million automobiles using liquefied petroleum gases, and their share is 2.7% of the RF automobile fleet.

Despite the growth of LPG consumption by vehicle engines, in broad terms, it could be argued that the Russian liquefied gas market has not yet been formed. While in a number of

countries, LNG/LPG filling stations business is rapidly developing with a large portion of hydrocarbon resources used therein being imported from Russia, in this country it is being formed in the situation of non-transparent relationships between market entities and regulators. An example of successful development of LNG/LPG filling stations business is Poland where thousands of such filling stations operate, a real service industry has been set up and about a million jobs were created in the infrastructural sub-sector. Ii is expected that in future, LPG consumption by LNG/LPG filling stations, LNG/LPG filling points and small-scale power generation sector would grow; however, without increasing growth rates for the construction of requisite LPG sales infrastructure, the growth rates would be insignificant.

7 MEASURES AIMED AT FACILITATING THE DEVELOPMENT OF ENVIRONMENT FOR GAS-DERIVED CHEMICALS INDUSTRY, INCLUDING THE ENVIRONMENT FOR SMALL AND MEDIUM-SIZED BUSINESSES

1) To ensure development of gas-derived chemicals industry and small and medium-sized businesses servicing it, it would be needed to adopt measures aimed at securing support on the part of government agencies. A special feature of (government) measures aimed at supporting the gas-derived chemicals industry and, via it, small and medium-sized businesses, should be their comprehensive nature, i.e., creation of an efficient and reasonable market environment (including coordinated efforts in the spheres of normative legal, customs, antimonopoly regulation, organisational, financial & credit and tax measures aimed at ensuring the relevant conditions). The basis for the development should be the cluster form of industry organisation implemented by means of public-private partnership. Special economic zones, technology parks, business incubators should be set up.

2) Infrastructural assistance. Government participation in the creation of infrastructural facilities, transportation pipeline & system, installation of facilities at sea ports and rail terminals, facilities for deep conversion of hydrocarbons to gas-derived chemicals and petrochemicals, site creation, utilities construction, railways, automobile roads, ports, etc.

3) Encouragement and support for strategic initiatives undertaken by economic entities engaged in innovative activities. Development and creation of incentives for their own R&D efforts.

4) Tariff regulation. Government influence on energy resources pricing for basic types of such resources.

5) Customs regulation. Diversified approach to customs duties.

6) Creating conditions for encouraging deep conversion of semiproducts at enterprises of small and medium-sized businesses within the sectors producing products for ultimate consumption.

7) Tax and normative legal regulation. Tax holidays for companies, as well as other tax preferences.

8) Promoting domestic demand for products of gas-derived chemicals industry and small and medium-sized businesses. Developing effective demand for gas-derived chemicals and petrochemicals by means of government orders in the interests of military-industrial, housing and utilities, and other sectors.

Establishing suitable financial conditions for the development of enterprises producing gas-derived chemicals and petrochemicals. Regulation of loan interest rates (interest rates subsidies). Improvement of the situation relating to the provision of long-term loans. Setting up venture funds.

Creation of incentives for attracting direct foreign investments. Repayment of a portion of interest on loans granted to small businesses for implementation of such projects.

9) Information support. Establishing a central information service in order to perform consulting, analytical, marketing functions for supplying small and medium-sized businesses with necessary technical and economic information.

10) Setting up a permanent institute for public expert examination of suggestions relating to the development of PGDC industry and oil and gas refining sectors on the basis of Delovaya Rossiya (Business Russia) All-Russia Non-Governmental Organisation.

11) Establishing joint ventures within the framework of Technologies in Exchange for the Market scheme.

12) Support for export (export loan insurance, subsidized interest rates).

13) Facilitation of integration of a wide range of government and private entities (universities, government and private research centres, laboratories, small and medium-sized industrial enterprises).

14) Setting up a modern system of documents pertaining to standardization and technical regulations in the spheres of gas-derived chemicals industry, petrochemical industry, gas and oil refining and gas distribution harmonized with the Western technical regulation system.

15) Implementation of public-private partnership (PPP) in the course of setting up gas processing facilities.

The latter may involve, for example, inclusion, in PPP projects for development of territories (for instance, Krasnoyarsk Territory, Republic of Sakha-Yakutia, etc.), of a possibility to develop not only large-scale gas refining facilities (GRP), but also GRP of small and medium-sized oil and gas production facilities setting up of which is not generally provided for in such PPP projects being similar to PPP for the development of South Yakutia, Lower Priangarye (Lower Angara Area). It may also provide for government financing for the creation of road infrastructure for small and medium-sized oil and gas fields selected by certain criteria.

One of the examples of creating PGDC facility clusters in different regions of the country on a PPP basis is cooperation between business community and administration of Khanty-Mansi Autonomous Area (KhMAO) in the course of setting up and functioning of KhMAO-Yugra PGDC facility cluster involving the development of transport infrastructure, granting of financial preferences for its development.

16) Harmonisation of Russian and foreign standards regulating small GRPs.

This can include adoption, by Rostekhregulirovaniye (Federal Agency for Technical Regulation and Metrology), of a programme for creating a package of modern national standards for set of equipment at small GRPs (including the relevant conceptual framework, performance

specifications) harmonised with the Western ones. It should be noted that currently, there is no package of modern national standards for set of equipment at small GRPs whatsoever in Russia, and supervisory authorities have to use the existing standards for large GRPs, which results in significant growth of ultimate cost of small gas refining facilities.

17) Liberalization of investors' access to APG and UGC resources. Setting-up a government federal marketplace for trading in the APG and UGC.

18) Establishing a supervisory agency in the form of a government agency or federal state establishment of the Ministry for Energy – a committee for state inspection within the oil and gas industry for supervision of achieving the goal of bringing the utilization level to 95% and improving efficiency of APG and UGC use and, *inter alia*, approving oil and gas companies' programmes for APG utilization.

19) Setting-up a federal marketplace for trading in LPG on the RF regional markets.

8 AS A SUBSTITUTE FOR CONCLUSION: ON STIMULATING ADDED VALUE GROWTH IN THE OIL AND GAS COMPLEX

RF's position in the global economy is closely associated with crude oil and natural gas exports. While shares of Russian sales of these raw materials on the global market are 12% and 25%, respectively, proceeds from oil and gas sales constitute up to 44% of the federal budget revenue. Meanwhile, it's evident that a different structure of external demand for primary energy commodities coming from Russia would be formed in a global post-crisis reality. According to expert estimates shared, among other entities and persons, by the Ministry for Economic Development, it's very likely that as early as by 2013-2014, exports share in country's GDP would fall by one third (down to 20%), which could result in instability of the current account of the balance of payments and have a negative impact on national currency exchange rate trend.

To cope with such a potential situation, it would be necessary to focus government's regulatory and stimulating efforts, among other things, on forming a "new oil and gas offer", which should include both diversification of sales markets (first of all, consolidation of Russia's positions in Asia-Pacific Economic Cooperation) and creation of new product lines on the basis of accelerated development of oil and gas refining, PGDC sectors, which, in its turn, would drive head-on modernization of ultimate production facilities (consumer and special chemicals sectors).

The situation becomes more complicated due to mixed and ambivalent trends in global oil and gas production. Up to 2030, fossil fuels would remain to be the dominating sources of energy. Their share could constitute up to 80% of the global demand. Oil would preserve its leadership. According to BP estimates, more than 3.8 bn tons of oil was extracted in 2009. It seems that its production would stabilize by 2020. By 2030, overall global demand for gas would grow by 55% (compared to 2005 level). Moreover, many experts believe that during the next few years, its excess supply would continue, and downwards price pressure would persist. The main reasons for that would be shale gas and insignificant capacities for the production of liquefied natural gas (LNG) existing and being commissioned in Persian Gulf countries.

It's worth noting that it is the LNG which is the basic product for the global gas market being currently formed (having its own pricing model being independent from that of the oil pricing). Russia's 5% share in the global LNG market should be consistently increased; otherwise, rules of the game on the new market would be formed without participation of the potentially largest gas producer (23% of the world reserves of natural gas).

It should be noted that lower carbon intensity of gas (compared to those of oil and coal) would ensure smooth growth of demand for the gas in the US and Europe (on the average, by 0.8% each year over the period up to 2030). In Asia-Pacific Region, the demand over that period would

increase more than two-fold (on the average, it would grow 4% per year). LNG share in covering the Region's total demand would be greater than one third.

However, it would be far too early to decline to give up on gas delivered through pipelines. At least, during the next 15-20 years, depending on growth rates of LNG share in the global consumption, the gas delivered through pipelines would continue to be one of major guarantees for security of energy supply on a global scale and a material basis for building a common energy space of European Union countries and Customs Union/CFMZ.

At the same time, growth of our traditional oil and gas exports has already been hampered by physical limits, and it would not continue to be the main revenue growth driver, as it was in the pre-crisis period. This goal could only be achieved by increasing added value generated from processing of primary energy feedstock and gas-derived chemicals industry, which should be developed in the foreseeable future ***faster than the oil and gas production.***

World's current aggregate revenue from sales of products of PGDC sectors in $3 trillion, which is comparable to that of the global oil market. By its money turnover, the global trade in polymers is coming closer to that of trade in ferrous metallurgy products. Market value of certain low-tonnage products is sometimes higher than that of gold or precious stones. Upon four or five hydrocarbon raw materials processing stages, the value of final output increases from eight- to ten-fold. An example of such value chain is as follows: natural gas – ethane – ethylene – polyethylene – items made of polyethylene. Moreover, value of some of products (after 7 or 8 stages of oil and associated petroleum gases (APG) processing) is 100 or even more times greater than that of similar volume of raw materials. In Russia, many of the highest process stages known in the world practice, have not been implemented at all. Thus, the share of final consumer goods in chemical industry output is just 10%-15%, or 2-3 times lower than in the US, Germany, France or other countries.

Let's remind you that by its chemical industry output in record high year 2008, Russia occupied 20-th position in the world, and Russian enterprises produced just 1.1% of the world's chemical products output. Furthermore, per capita output (in physical terms) of plastics and synthetic resins is 4 times lower than in Japan, almost 8 times lower than in the EU, and more than 10 times lower than in the US. The gap in output of chemical fibres and man-made yarns is even greater – Russia's per capita output of such products is 13 times lower than in the US and 9 times lower than in Japan.

In addition to availability of considerable "reserves" of "undeveloped" added value, strategic priority of PGDC sectors results also from the fact that it (in the course of their modernization) could become a sort of a foothold for Russian participation in the global "new materials race" having already started now. A materials revolution is the most important component of transfer to a new technological mode. This process has already started, and its visible phase is expected to begin

in 2015-2017. Chemical products having fundamentally new application opportunities would appear on the market. It would be the result of emergence of polymer-based thermoplastic composite materials; long-life plastics; Arctic types of fuel; materials capable of self-diagnostics and self-adaptation; hi-tech fibres of a new generation; self-regenerating environmentally-friendly rubber; smart nanomaterials changing their form at user's will; polymers having an active membrane function capable of sorting molecules; amorphous polymers repairing damaged coatings; biocompatible and biodegradable materials, etc. Many international experts link the transfer to the new technological mode to the formation of the global market for gas as a "new wave" basic raw material.

New post-crisis realities of the global economy make it a sort of an imperative for oil and gas producing countries to increase output of final products in order to preserve their competitiveness. The more regular becomes the pattern under which competencies in final products determine the requirements to quality of products produced at different process stages, while prices and fluctuations of final demand form price bands for raw materials, semi-finished products and other items. Moreover, a seeming convenience of such price bands is a deceptive one: without a clear focus on final demand, one could incur a serious damage due to "new derivatives" of the raw materials exported status, since sale of semi-finished products is just a little better than exports of oil and gas delivered through gas pipelines. The value of gap with final products based on oil and gas feedstock would only grow.

Thus, a structural change towards the supply-side economics in the Russian oil and gas sector would have, in point of fact, no alternatives. Its success would directly depend upon coordination and consistency of actions over the entire chain: production – processing of oil and gas (including APG utilization, production of fertilizers, as well as extraction of methane from coal beds) – PGDC sectors (which should be considered today as a single sector) – final products of the chemical industry.

The RF Government has already adopted a number of important decisions in this sphere. General schemes for the development of the oil sector for the period of up to 2020 and of the gas sector for the period of up to 2030 have been approved; works relating to preparation of a similar general scheme for the PGDC sector have been started; standards for disclosure of information by natural monopoly entities rendering services pertaining to transportation of gas by pipelines have been approved. Thus, building blocks have been created and are being created for a larger government managerial system – ***the strategy for setting up of a single energy and chemical complex based on priority development of the PGDC sectors, in the RF*.**

One of the most notable trends in modern global economy is formation, alongside with specialized business entities, of versatile companies comprising the entire vertical – from

production of energy feedstock (and ownership of energy assets) to PGDC production facilities. The existing share of the latter, increasing companies' stability on the market, also results in growth of their capitalization. The share of PGDC divisions in overall revenue of Exxon Mobile, BP, Royal Dutch Shell, Total, Chevron-Texaco, Conoco Philips and others has already exceeded the 10% level. On the whole, at least half of petrochemical products and gas-derived chemicals is produced by oil and gas companies. Leading Russian companies are far from being at the top of this world's table of ranks.

Another important circumstance is that preserving the current level of oil and, especially, gas processing would in the coming years mean boosted export, together with the raw materials, of potentially larger added value than today. There have already been noted certain cases when in European countries, their ethane component (the most important feedstock for PGDC sectors) was intensively extracted from gas obtained under long-term countries. Meanwhile, in the RF, development of fields containing so-called fat gas (ethane content of 5% or more) would be started quite soon – by 2025, the share of such gas in the gas balance would reach 60%.

In this situation, an economic substance of a single development strategy for oil and gas production, processing and PGDC sectors and their integration into a common energy and chemical complex is switching of potential added value flows to national economy and forming a driver for its future sustained growth.

It appears that ***the principle upon which such strategy is to be built, should be domination of competencies in final products***. The starting point should be the development of the PGDC sectors matching forecasts of demand dynamics in consuming sectors (construction and production of building materials, road facilities, metallurgy, engineering industry, production of fertilizers and agrochemical industry means, defence industry, etc.). This is also a condition for better reliability of forecasts for oil and gas production and processing dynamics, commissioning of transportation capacities and other supporting infrastructure and logistics. It is also important that today, the PGDC industry is inseparable from reducing environmental load: in accordance with the existing global practice, in case of constructing PGDC plants, up to 10% of the investments are directly related to environmental protection measures.

Several growth points have formed in the global PGDC industry. PGDC clusters in Saudi Arabia, South Korea, China, India and some other countries have been added to traditional PGDC centres existing in the US, Canada, Western European countries, Japan.

In the past, the USSR was also one of the growth points and major PGDC centres. In the post-Soviet era, the domestic PGDC industry lost its advanced positions. Nevertheless, Russia has every potential opportunity for becoming once again a largest centre for the production of petrochemical products and gas-derived chemicals. To achieve this, ***at least, the following three top***

priority issues should be resolved: radical technological upgrading of the oil refining industry should be performed; share of feedstock for PGDC industry coming directly from the gas sector, should be increased drastically; at least, 5-6 industrial & innovative clusters in the PGDC industry should be created over the next 10 years.

The existing process-related structure of the Russia's oil and gas refining industry does not meet modern global requirements, as far as deep processing of feedstock is concerned. Ranking third after the US and China, with its share of 6.63% in primary crude oil distillation capacities, the RF lags behind leading countries 2 or 3 times by its share of secondary and destructive processes. Most of Russian oil refineries were constructed within the framework of previous technological modes: 98% of oil is refined by plants commissioned as long ago as in the Soviet era. Average wear of their equipment is 80%, actual operating life of some units and components is several times longer than their design useful life. Out of 27 major oil refineries, six were put into operation before the World War II, another six – before 1950, and eight more – before 1960. Therefore, revamping of the oil processing facilities is an absolute imperative capable, and this is important, of creating incentives for engineering industry development. According to expert estimates, at least 90% process-related needs of the sector could be met by Russian-made equipment.

The existing structure of the raw materials base of the PGDC industry should be changed. The world's average ratio is 60% of oil to 40% of gas. In Russia, being the largest gas producing country, the share of gas is just 25%. Roughly the same figures are demonstrated by Japan and EU, i.e., the classical raw material importers. At the same time, in the US, Canada and some other oil and gas producing countries, the share of gas (ethane, propane-butanes, etc.) in the total amount of feedstock consumed by PGDC industry reaches 70%. Objective (production-related) conditions for reaching such levels does exist. Valuable components are present in gas contained in deep horizons of operating fields located in northern areas of Tyumen Oblast. Kovykta Field in Irkutsk Oblast has increased ethane content. The gas from recently discovered deposits in Northern Part of the Caspian Sea has also increased ethane content. The same could be said about a number of gas condensate deposits in Eastern Siberia.

Calculations demonstrate that the potential for extracting valuable components from gas for gas-derived chemicals sector is, at least, 50 million tons (while actual amount of such components extracted in 2008 was 10 million tons). A significant reserve is rational utilization of APG (currently, more than 70% of APG is combusted as feedstock for field-based electric power plants, or flared).

To ensure growth of gas feedstock share in PGDC industry, it would be necessary to fully perform the RD Government resolutions on setting up new pyrolysis facilities to eliminate the deficit of monomers and other products of basic organic synthesis. In addition to their high

profitability, reaching as high as 15-20% such facilities create the basis for higher process stages, where the financial results are two times higher (e.g., in case of producing finished consumer products by means of extruders). Moreover, it becomes possible for Russian producers, in principle, to cover new demand niches, such as geosynthetics and thermoplastic elastomers for road construction sector.

One more promising sphere to which no sufficient attention has been paid, is the development of GTL (gas to liquids) technologies making it possible to produce high energy fuels having improved environmental characteristics, methanol and other products, from gas.

Situation on global markets would have an impact on decisions which would be taken in respect of development of the PGDC industry. On the one hand, there exists a fairly noticeable risk of boosting of imports for many kinds of polymers. At the same time, construction of quite a few PGDC facilities is underway in the world, and putting of these facilities into operation by 2012-2015 could result in overproduction, and the market could collapse. It means that competitive positions would be increasingly determined, in addition to traditional minimization of costs, by the ability to offer new products having maximum individualization of their consumer properties (the so-called "needed product in necessary time and in requisite place" principle). Due to this reason, the PGDC industry is inherently becoming an innovative science absorbing and hi-tech industry. The most promising organisational & managerial form ensuring integrity and, accordingly, synergetic effect of innovation processes is PGDC industry-related clusters. They have already been formed in the US, Canada, Japan, European countries, Saudi Arabia, and they are being currently formed in China and India.

In Russia, one may deem a concentration of specialized enterprises in Tatarstan (Nizhnekamsk Petroleum and Gas-Derived Chemicals Industry Integrated Works, Kazan' Organic Synthesis Plant, Kazan' Synthesis Rubber Plant, a number of educational, scientific research, design institutions, Alabuga Innovation Centre, an investment holding, etc.), to be an example of a petrochemical and gas-derived chemicals industry cluster. There exist prerequisites for the formation of a similar cluster in Bashkortostan too (Bashneft' ANK OJSC, together with Ufaneftekhim, Russian leader in 95% deep processing, Salavatnefteorgsyntez, Kaustik, Kauchuk, Soda enterprises in the city of Sterlitamak, etc.).

As far as the building-up of clusters on the basis of gas-derived chemicals facilities is concerned, such principal opportunities exist in the Komi Republic, Vologda Region (city of Cherepovets), Leningrad Region, Irkutsk Region (city of Sayansk, city of Angarsk) and Astrakhan' Region. In addition, a momentum for cluster-build-up could be given by the construction of new facilities in Krasnoyarsk Territory, Sakha Republic, at Sakhalin, as well as the development and

modernization of the existing capacities in Tyumen' Region (city of Surgut, city of Novy Urengoi, City of Tobol'sk) and Orenburg Region.

Upon taking of transportation cost growth into consideration, it appears to be expedient to consolidate newly created capacities. From this point of view, today, it would be preferable to concentrate efforts on forming new clusters in Irkutsk Region and in the Far East. In the latter case, one should choose between Khabarovsk and Primorsk Territories and Sakhalin Island.

Preliminary calculations of efficiency of standard gas-derived chemicals complexes having different specializations: basic (production of propylene and goods made of it), polymer (polyethylene, polypropylene and derivatives), chemical (production of ethylene glycols), petrochemical (alpha olefins and heat-transfer mediums on their basis) indicate that project internal rate of return would vary from 16% to 25%. Net present value would fluctuate from USD31 million to USD231 million. However, putting of new production facilities into operation would be costly. Construction of a modern gas refining plant having medium capacity (processing of 3 bn cub. m annually) would require not less than USD 400 million or USD500 million.

Significant capital intensity is typical for all links of the chain - from oil and gas production to production of end chemicals. Chemical industry (including petroleum and gas-derived chemicals industry) is No. 3 in today's global economy by investment volume (in the developed countries, it accounts for 11% - 16% of the aggregate investments, with its 14% share in the total fixed capital).

This tendency is fully confirmed by the Russian practice. According to experts' preliminary estimates, fundamental modernization would require from RUR3 bn to RUR5 bn. The 'resetting' of oil and gas production and refining, transport capacities and logistics, securing the modernization, looks even more large-scale. Inception of the 'resetting' was initiated by the general schemes for the development of both industries. Investment volumes in this sphere are predicted to be not less than RUR20 bn. It could be expected that in the course of implementation of the projects, these figures would grow.

Materialization of the forecasts directly depends upon investment risk level. The most critical **conditions for their mitigation are the priority, from government point of view, of this line of scientific & production innovative development, as well as sustainability and predictability of regulatory environment**. One can judge about significance of the latter by the fact that due to specific features of the regulation, refining industry and petroleum and gas-derived chemicals industry projects are, on the average, one third more expensive, in Russia than in the EU. At payback periods of 5 to 7 years (for especially large capacities – up to 12 years), this is a material burden comparable with a tax one.

It would be logical to suggest that for business entities comprising advanced process stages production facilities, generation of cash flow being necessary for the investments, would begin from

the oil and gas production. Meanwhile, in case of the existing tax system, according to an official assertion of the RF Government, development of 90% of reserves of new fields and 30% reserves of already existing fields would not be profitable. In case of oil, it is so with almost half of all demonstrated reserves. Such estimates are still to be made in respect of gas.

The Ministry of Finance intends to suggest the introduction, in 2012, of a new taxation model for the oil sector: introduction of a special fiscal regime for new deposits; differentiation of the Mineral Extraction Tax; transfer to an Excess-Profits Tax charged from free cash flow, rather than from accounting profit. The general approach (i.e., to collect maximum amounts when productivity of a deposit becomes the maximum one) could only be welcome. In addition, putting new fields on line would generate additional revenue for the federal budget.

However, the problem is that the oil refining sector is not covered by tax-related stimulating innovations. Focus on equalisation of export duties for light and dark petroleum products and their bringing closer to the export duty for oil would have been justified if it has been accompanied by tax-related support for the development of advanced process stages. This has not happened yet. It is not also clear whether the oil refining would be subsidized in the event of bringing closer the duties for oil and petroleum products, the right for doing which was reserved by Russia within the framework of the Customs Union (in particular, it is unclear, how the proceeds from duties for oil and petroleum products levied by Byelorussia but credited to Russia's budget would be spent).

In the situation of general imbalance between stimulating and fiscal functions of the tax system, the gas refining sector and the PGDC industry are the most vulnerable ones within the oil and gas complex. To rectify the situation, it would be expedient to apply to groups of companies developing their PGDC-related component, ***a consolidated taxpayer mode*** with relevant tax-related control over their transfer pricing. In addition, it would be needed ***to determine tax-related identification criteria*** for innovative and hi-tech business entities operating in the PGDC sphere in order to provide them with fiscal privileges stipulated by the existing legislation.

A special institute for the development of oil and gas refining and PGDC industry focused primarily on supporting projects within the framework of clusters being set up pursuant to the general schemes for the development of oil and gas sectors, could have become a tool compensating the shortage of tax incentives for investments. The necessary prerequisites would be the competitive selection and implementation of projects on the basis of public-private partnership. The source of funds for the period of up to 2014 would be a part of resources managed by VEB, and thereafter – oil and gas transfer calculated on the basis of average oil and gas prices over the period of at least 10 years.

It seems that such an institute could also be in charge of projects for nitrogen fertilizers production (technological modernization of facilities for the production of ammonia and urea could

ensure the reduction of the sector's gas consumption by 4 bn m^3 per year, which, in case of $270 per 1000 m^3 would be equivalent to an additional $1 bn of additional revenue from exports). Alternative solutions would require either preferential gas prices for the producers, or their independent access to gas deposits.

Another method of gas saving is the development of coal fuel-related chemical technologies (for instance, injection of concentrated powder coal into blast furnaces). However, other opportunities also exist in this sphere. For example, use of new technologies for use of methane produced from coal beds would become profitable (project payback period is reduced to three years) in case coal companies are provided with a broad access to the mechanisms for the implementation of the Kyoto Protocol.

Immensity of objectives relating to the creation of modern and competitive oil and gas refining sector and PGDC industry, as well as economic effect of achieving them being visible even now, justify raising an issue of ***preparing*** **(at transfer to a new classification of budgetary expenditures)** ***of a separate government programme titled "Energy and Chemical Complex Development"***. In addition to concentration of financial resources provided within the framework of government support, it would have also provided a matrix of other necessary regulatory actions.

In the first instance, it relates to the adoption of a considerable number of technical regulations both within the refining sector and PGDC industry (a case in point is the lack of regulatory control in respect of the gas engine fuel), and in sectors consuming their products (first of all, housing and road construction sectors). Other obvious spheres would be arranging government supervision over rational utilization of APG; encouraging competition and setting fair competitive prices through the development of exchange trade in oil, gas, liquefied petroleum gases, oil and gas refining products and products of the PGDC industry; elimination of controversial practices in the antimonopoly policy.

These measures should be considered to be just basic ones for the creation of the regulatory environment being comfortable for generating added value flows in oil and gas complex, where the PGDC should have a leading role as a connecting link between the producing sectors and the production of final chemical products.

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