

# Analysis of Strategy of the Petrochemistry Development till 2015

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**Abstract**—The Program of Russian Federation Government “Development of Strategy of Chemical and Petrochemical Industry till 2015” is analyzed. The program determines the priority lines of petrochemistry development in Russian Federation.

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At November 2007 the Russian Federation Government announced “Strategy of development of chemical and petrochemical industry of Russia for the period till year 2015,” one of the basic leading documents for the managers of chemical and petrochemical industry on the nearest perspective. The strategy defines priority directions of petrochemistry and pathways for their realization in regions and in the economy of the country, the role of state–private partnerships in petrochemistry branch. It serves as a basis for the accepting decisions on the state level.

The purpose of this publication is to inform the journal readers about the main statements of this document.

## General Characteristic of the Branch

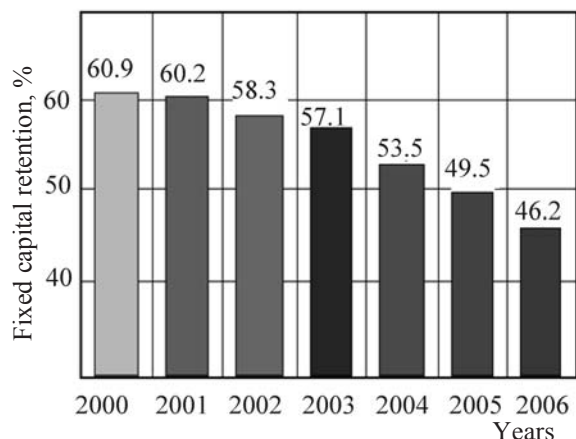
The products of petrochemistry find application in all industrial branches, in transport, agriculture, defense and fuel-energy complexes, in the sphere of service, trade, science and education. The products of petrochemistry are used in basic organic synthesis—9.6%; at producing plastic products—12.1%; for rubber parts—7.7%; chemical means for plant protection and other agrochemical products—0.2%; production of synthetic fiber and rayon—1.3%; varnishes and paints—2.3%; synthetic rubber—9.0%; plastics and synthetic gums—8.5%, and others. Now Russia produces about

1% of the global petrochemical products and occupies 20-th position in the world (leaders are USA, China and European Community).

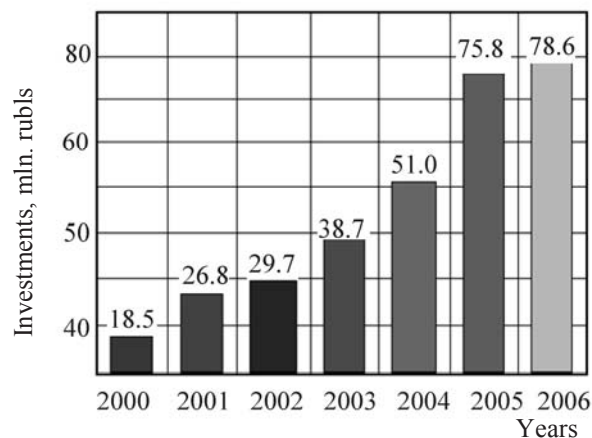
Contribution of petrochemistry to the gross domestic product of Russian Federation is not significant: in 2006 1.7% (in 2005—1.9%). The industrial production index (respectively to preceding year) in this branch was in 2006 104.2% (in 2005 103.3%). The coefficient of wear of the fixed capital in the period 2000–2006 increased continuously (Fig. 1) indicating insufficient investment to the fixed capital (Fig. 2) and spending these investments basically to the environment saving actions (Fig. 3).

The portion of petrochemical production in the all-Russian export in 2006 was about 4%, in import about 7%. In the world-wide export of petrochemical industry the share of Russian goods is extremely low, approximately 0.6%.

The enterprises of petrochemical complex are concentrated in essence into four federal regions: Central (24.4%), Southern (10.4%), Volga (43.5%) and Siberian (11.2%). The largest petrochemical productions are located in the republics of Tatarstan and Bashkortostan, in the Altai, the Permian and Krasnoyarsk zones, in Tula, Tyumen', Yaroslavl, Nizhny Novgorod, Volgograd, Samara, Kemerovo



**Fig. 1.** Degree of the safety of the fixed capital in the petrochemical branch in 2000–2006.



**Fig. 2.** Fixed asset formation in the petrochemical branch in 2000–2006.

and Irkutsk regions, and to a great extent contribute to the development of these regions.

In the chemical complex 79–89% of enterprises are private, 3–6% belong to state, 3–4% in joint Russian and foreign property, 1–2% in the municipal property, 1.3–1.4% in foreign property.

In some branches of petrochemical complex there are large corporations, such as Sibur-Holding, Lukoyl-Neftekhim, Tatneft', Evrokhim, Akron, Amtel and others, that produce about 40% of polymer materials, from 50 to 70% of various forms of synthetic rubbers, 82 passenger and 95% of cargo automobile tires. In the structure of Russian petrochemical complex the companies with one-two plants occupy essential portion.

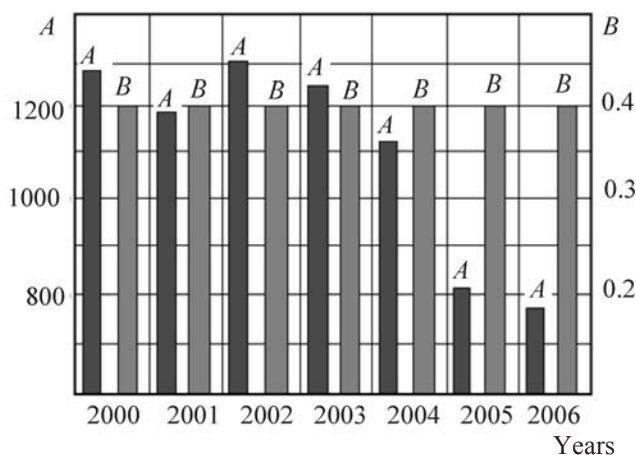
In the total volume of processing enterprises production the fraction of the enterprises of petrochemical complex according to the data in 2006 is 10.2%.

In the petrochemical branch are employed more than 791 thousand people, this value includes the fabrics producing rubber and plastic products where employed more than 255 thousand people.

### Market and the Competitive Ability of Russian Petroleum Chemistry

During the period of 2000–2006 the export of petrochemical production in Russia in the monetary stock grew more than 2.5-fold (Fig. 4) which is connected to a great extent with the increase in the world prices of chemicals. In 2000–2004 the rates of increase in the export anticipated the rates of increase in the import. However, since 2005 the rates of increase in the import exceed almost twice the respective index in the export as a result of an increase in the domestic demand and insufficient assortment of domestic petrochemical production (especially in the field of low-tonnage chemistry). In spite of this, the balance of the foreign trade turnover of the petrochemical complex production remains positive for the period of more than 15 years.

Up to 40% of Russian petrochemical production is exported. From the country is exported predominantly the production of low processing and is imported the production of the deep processing: synthetic fibers and thread, synthetic resins and plastics and products made of them. The export nomenclature practically did not undergo changes: the mineral fertilizers 34.3; synthetic



**Fig. 3.** Volumes of ejections in the enterprises of the petroleum chemistry: (A) the discharge of effluents into the surface reservoirs, mln. m<sup>3</sup>; (B) ejections into the atmosphere of pollutants, mln. ton.

rubber 9.2; plastic and synthetic resins 5.3; ammonia 5.3; tire 3.7; caprolactam 3.1; styrene 2.8; methanol 2.2% of the currency income.

In contrast to the export the nomenclature of Russian import is varied, traditionally prevail goods with the high gross value addition: plastic products (23.4%), plastic and synthetic resins (18.6%), automobile tires (6.8%), paints (4.9%), synthetic fibers and thread (4.1%), the chemical means of plant protection (2.2%), rubber products (3.4%), wash means (1.3%), catalysts, plasticizers and other.

The Russian petrochemical production users are the markets of the countries of European Union (32.5%), of CIS (24.2%) and of Asian- Pacific Ocean region (20.4%). Russian export in a great extent is affected by the introduction of protecting and anti-dumping measures in some countries (USA, European Union, China, India, Mexico, Brazil, Philippines, Australia, Indonesia). The restrictions concern the export of synthetic rubbers, epichlorohydrin, bisphenol-A, polytetrafluoroethylene (fluoroplast), alcohols (butanol, isobutanol), trichloroethylene, polyvinyl chloride, caprolactam. The accounting for these prohibitive actions is especially important at the planning creation of new petrochemical enterprises and development of the already existing facilities.

The domestic market of chemicals was reduced sharply in the years of economic crisis. Delivery to the foreign markets became the sole source of income of many domestic producers. Export gives almost half of the joint gain of enterprises in the branch, moreover in the separate sectors this index exceeds 80% (caprolactam, xylenes and other). For example, xylene is produced for the export mainly. However, it is

necessary to import more than 90% of the products of deep processing of xylene (for example, polyethylene terephthalate).

Development of chemical complex was stimulated by the sharp increase in the world prices of the hydrocarbons, which resulted in an increase in the prices of the chemical production. This became the main reason for reanimation of petrochemical industry in 2003–2004.

The domestic producers of highly technological products (tires, lubricants, structural polymers, varnish and paint production) which use the chemical raw materials can difficultly compete with the foreign ones. The product volume of synthetic fibers, paints and varnishes in recent years either was reduced or it grew insignificantly.

At present in Russia the production of some forms of polymeric materials (polyimides, polycarbonates), special-purpose natural rubbers, glues, sealing compounds, etc. is cancelled. The production of all carbon materials necessary for preparing the construction heat-resistant and corrosion-resistant composite materials for aviation, rocket-space technology and atomic energy industry is under the threat of closing. In the critical state is more than 42% of low-tonnage enterprises producing boron and silicon-carbide fibers, heat-resistant organic glass, thermoresistant silicon and heteroorganic oligomers, fillers, pigments, etc.

By production and consumption of the petrochemical products per capita, Russia is substantially behind the developed countries. Production of plastics and synthetic resins (kg per capita) in 2005 in Russia was 25.9; in the USA 276.4; average in the group of

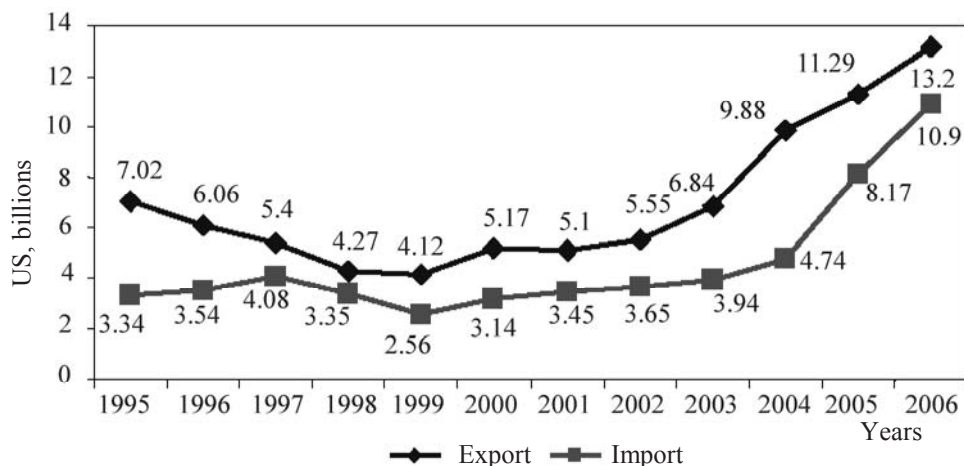


Fig. 4. Dynamics of export and import of the chemical and petrochemical production.

**Table 1.** Demand for the chemical production at the domestic market (thousand ton)

Production	2006	2010	2015	2015 relatively to 2006, %
Synthetic fibers and the thread	274	418	540	197.1
Polyethylene	1206	1670	2470	204.8
Polypropylene	423	670	960	227.0
Polystyrene and styrene copolymers	325	465	670	206.2
Polyvinylchloride and vinyl chloride copolymers	742	905	1470	198.1
Polyethyleneterephthalate	449	695	935	208.2
Polycarbonate	22	50	60	272.7
Paints	1176	1460	1860	158.2
Synthetic washing means	759	1100	1220	160.7
Synthetic resins and latexes	551	835	1350	245.0

**Table 2.** Demand for the basic forms of chemical production on the internal and outside markets (thousand ton)

Parameter	2006	2015	2015 relatively to 2006, %
Synthetic fibers and the thread	324	690.0	213.0
Synthetic resins and the plastic	4829.1	9790.0	202.7
Paint	1261	1980	157.0
Synthetic dyes	37.0	70.0	189.2
Synthetic washing means	900.5	1390	154.4
Tires, mln. pcs.	54.2	92	169.7

countries of the European Union 200; in Japan 104.5; synthetic fibers and threads in Russia 1.1; in the USA 13.5; in Japan 10.3. There is delay in such important characteristics as portion of plastics in the structure of construction materials and portion of synthetic fibers in the balance of textile.

The dynamics of the consumption of petrochemical production on the Russian market of 300 most important products shows an increase in the domestic demand for the industry, agriculture and transport. Internal consumption of some products exceeds 90% (polyethylene, polypropylene, polystyrene, polyethylene terephthalate, synthetic rubbers). Rapidly developing is the construction industry and the housing sector adaptig polymeric materials, glass- and fiber-rein-

forced plastics, foam plastic, glues, varnish and paint production and other chemical products (Table 1). In mechanics industry the demand for the polymer construction materials, the special paint and varnish coats, thermoinsulating and sound-protecting materials and other in many instances irreplaceable materials, grows. Defense safety and economic independence are impossible without the development of domestic petroleum chemistry, since there is no alternative to many materials for the weaponries. Without the contemporary materials of petroleum chemistry is impossible further development of electronics and broadcasting, production of remedies and cosmetics, products of everyday use.

Forecast of demand for the basic forms of the production of petroleum chemistry in 2015 is repressed in Table 2. The situation is influenced by many factors, including an increase in the world prices of the oil, the expansion of demand on the domestic market, the inflation, strengthening of the exchange value of ruble and rise in price of goods and services of natural monopolies, the liberalization of foreign trade regime in connection with the intention of Russia to enter in World Trade Organization, the protection policy of some states (USA, the European Union, China, India) toward Russian petrochemical production (the mineral fertilizers, synthetic rubbers, caprolactam, alcohols and others), the intensive growth of export from the countries with the cheap hydrocarbon raw material (especially the countries of Near Eastern region). Comparative analysis of the funds creation (billion dollars in USA) shows the shift of the Russian petrochemical sector to the side of low processing (Fig. 5).

This situation is reflected by the structure of export and import and the structure of expenditures for production: the cost of raw material and semifinished products (53.1%), labor cost (12.4%), power charges and fuel (11.1%). For the majority of the petrochemical production Russia can compete only due to the low prices. This advantage will be lost with the approximation of internal prices and tariffs on the gas and the electric power to the world level.

The production of the deep processing have no reserve of competitiveness owing to its low quality because of the use of the obsolete technologies with the high consumption of raw material and energy, and due to high wear coefficient of the basic technological equipment.



Entering of Russia to WTO would make it possible to regulate the conflicts connected with the anti-dumping limitations and will increase the openness of domestic market. The latter will lead to reduction in the competitive ability of Russian petrochemical products, since after 2011 the price advantage of petrochemical production will be levelled. Actually in 2006 the profit of the branch reduced in comparison with the previous year from 116.6 to 110.7 billions rubles, and expenditure for 1 rub productions (goods, works, services) increased from 86.7 to 89.4 kopecks, that is above the average level on the processing branches (86.6 kopecks). The negative factor of reduction in the profit will become also the stiffening of ecological requirements for the production.

### Problems, Criteria and Indicators of Strategy of Development

The basic system problem of petroleum chemistry in Russia is in the inconsistency of the petrochemical production and its market that indicates crisis of the branch. The crisis of branch will have not only economic, but also negative social consequences, since the important petrochemical enterprises are frequently town-defining ones.

A change in the structure of supply and demand of petrochemical production is the basic source of the problem. The assortment of the majority of Russian petrochemical enterprises was formed as far as in 1980th years and it does not correspond to international standards.

In particular, thermoplasts predominate in the plastic production in rather old forms while producing of foremost elastomers is insufficient. Therewith, even in the sector of basic large-capacity thermoplasts the structure of products does not include the most claimed sorts (for example, linear low-density polyethylene). Overall situation can be illustrated on the example of polystyrene. Demand for the high-quality forms of the special-purpose polystyrene (heat resistant, impact resistant, acid resistant and with other special properties) is covered by the import. The quality of the traditional domestic types of polystyrene is rather low and Russian users are forced to reject it despite low prices. For the mass demand production is important not only functional properties, but also safety and decorative properties. As a whole, with increase in solvency of customers the demand for the qualitative production grows, dynamics and structure of the

consumption of petrochemical production in Russia approaches world standards, and the distance between the structure of produced materials and the demand increases.

An example of geographic structural changes in the market is the active development of petroleum chemistry in the countries of the Near East, therewith some important users of the Russian production, for example, Chinese Peoples' Republic, instead of the import develops its own production and export.

Essential transformations occurred in the recent two decades also in the investment processes. The industrially developed countries have focused themselves on the production of highly technological materials of special designation. At the same time, the large-capacity productions of half-finished products of petrochemical industry are transferred actively into the regions with the cheap raw material and labor resources. For instance, for the creation of polyethylene facility in Venezuela per a unit of product (1 ton) is required 900 US dollars, while in Sweden almost 1500 dollars.

Technical backwardness and high wear of the fixed capital is another key problem. In the petrochemical complex they the facilities reach practically maximum level of the use (82–100% on the some sorts of productions). Coefficient of wear of basic productive capital in 2006 in the petroleum chemistry was of about 46%, of equipment of about 48%, moreover on the separate types of equipment up to 100%. A substantial part of the equipment works for 20 years and longer. The coefficient of the fixed capital renovation is 4 times lower than the minimally required.

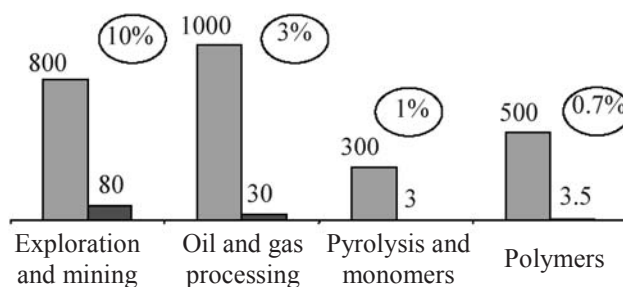


Fig. 5. Portion of Russia in the different stages of the chain of the cost creation.

*Low Innovation Activity of the Enterprises  
of the Petrochemical Sector*

Among the large and medium capacity enterprises of petroleum chemistry the number of those active toward innovations is less than 20%. Less than 10% production of this branch can be attributed to the innovation, and the part of expenditures for technological innovations is less than 3%. For the comparison the active to innovation enterprises in 2003 in Japan was 33.0%, in the republic of Korea 43.2%, in Great Britain in 2005 39.0%, in Germany 65.8%.

The material and technical base of the majority of scientific research and designing organizations now is destroyed. A significant drawn of scientific specialists occurs. Dynamics of the yearly financing of research and developments in 2002–2006 was the following: 2.5; 3.1; 3.6; 4.3 and 5.3 billion rub. Financial funding is clearly insufficient for the solution of the problem of competitive production. Russian companies prefer to purchase technology as the more rapid method of modernization. As a result the activity of domestic scientific and designing organizations does not substantially influence the state of industry. The distance between the objective needs of the industry and the proposals of scientific research and designing organizations continues to increase.

The situation is aggravated by the lack of development of the market for technologies, and also by the unresolved problems of protection and transfer of intellectual property, certification of innovations, laws and regularity in this area.

*Problems and Insufficient Effectiveness  
of Investment Process*

The economic crisis of the 90's and radical changes in the nature and structure of property destroyed investment process in the Russian petroleum chemistry. In 2006 investment volume was only 59.5% of the level 1991.

For the petrochemical production are characteristic high capital intensity and continuance of the compensability (more than 5 years), the complexity of internal production relationships. Therefore investment into one section of the technological chain is not effective. There are high ecological, infrastructural and raw risks connected with the uncertainty of the behavior of natural monopolies, insufficient facility for

the first step of the raw material processing and weak development of infrastructure.

Two practically opposite versions are the most attractive for investors under such conditions. The first is development of products requiring minimum number of technological steps to the output of commercial product, the second is investment into the technology with comparatively low expenditures and payback period (products of everyday chemistry, catalysts, paints, etc). These two versions obtained the greatest part of all investments into the petrochemical complex during years 1992–2004.

The majority of enterprises is forced to direct the substantial part of the profit to the coverage of a shortage in reverse capital and to the equipment repair. Only a few large companies can renew the fixed capital. The attraction of funds is hindered by the high percentage of the short term bank credits, therewith the period of payment (2–3 years) is considerably shorter than the period of the return in the most investment projects. Other creditors require as the guarantee of credit granting to them the shares of enterprises (in the form of guarantee or of portion in facility), on that the Russian companies go not too willingly.

As a whole the scarcity of financial tools characteristic for the Russian financial market and the inability of companies to use them retards seriously the development of investment process. Foreign investments, until now, do not play significant role in the development of Russian petroleum chemistry, mainly, they are oriented for comparatively cheap raw material and labor resources and relatively low ecological requirements, or simply they attempt to use the Russian market for supplying own products. Practically until now there were no realized scale projects with the foreign involvement in Russia, in contrast to China.

*Deficiency in the Normative-Lawful Regulation*

The following deficiencies in the existing mechanism of the normative-lawful regulation of the branch should be noted:

Large economic structures incapable to redistribute the flow of money in the promising trends.

The system of permissions at the design and building of new facilities, the presence of the stringent, partly uncoordinated and duplicated requirements of

numerous departments increase the periods of design, the cost of building, and as a result hinders introduction of new productions.

High prices for purchase and rate for the rent of the state and municipal land occupied by the objects of real estate belonging to legal entities.

Complicated access to contemporary foreign technologies and to complete supply of technological lines.

Export duties on the some forms of chemical production (butyl alcohol, polyethylene, polypropylene and others) decrease the competitiveness of petrochemical enterprises.

There are no efficient mechanisms stimulating energy economy, assortment renewing, deep processing of crude hydrocarbons and environment protecting.

#### *Limitations on Infrastructure, Resources and Raw Materials*

The steady development of petroleum chemistry is impossible without the hydrocarbon raw material that provides 80% of production of the branch. Primary light hydrocarbons (saturated and unsaturated hydrocarbons  $C_3$ – $C_4$ , light gasoline of direct distillation and monocyclic aromatic hydrocarbons) are obtained in the enterprises of petroleum refining from oil, natural gas and the gas condensate.

In Russia the basic oil and gas birthplaces are located in almost inaccessible regions. Due to climatic, transport and social complexities, creating network of collection and transportation of raw material as well as building of complex gas-chemical or petrochemical plants near the birthplaces is greatly complicated. More than 50% existing resources of casing-head gases at present are burnt in the torches, only 7% of natural gas undergo deep processing while respective world index is 12%.

A feature of processing petrochemical raw material in Russia is taking the hydrocarbons  $C_3$ – $C_5$  from the unstable gases or the gas condensates and the subsequent fractionating of the wide fraction of light hydrocarbons (WFLH) in the petrochemical enterprises. These hydrocarbons are transported by pipeline and rail transport, which increases the appropriate expenditures.

Because of the deep decrease in the effective demand for the petrochemical production the technical

base of the production of the initial products of organic synthesis for 15–20 years was not enlarged and was barely renewed. First of all this relates to the pyrolysis facilities where processed 73% of primary raw material of petroleum chemistry (besides the production of aromatic compounds in petroleum refiners) and products of which (ethylene, propylene and others) are used as the initial component of different chemical transformations. The insufficient productivity of pyrolysis facilities forces manufacturing the predominant part of linear monomers for the synthetic rubbers (butadiene, isoprene, isobutylene) using the old and energy-consuming technology of dehydrogenation (24% of primary raw material of petroleum chemistry).

Because of the high prices of the oil and the decrease in the domestic demand for the petroleum products, Russian petroleum companies were reoriented for the export of hydrocarbons, which led to stagnation of petrochemical industry. At the same time according to the experience of the development of petroleum refining in foreign countries the main pathway for increase profitability of the branch is deepening the oil processing and its integration with the processes of petroleum chemistry. About the unhappy situation in Russia one can judge from the following: the depth of petroleum refining in 2005 was 72% against 87–95% abroad. The yield of gasoline in Russia is 15.6% (in USA 43.3%). Diesel fuel and petroleum residue is produced twice over than is needed in Russia.

To the infrastructural limitations of the development of chemical complex should be also assigned a deficiency in Russian own ports. The ports of Estonia, Latvia and Ukraine at present are used.

#### *Inadequacy of Producing of Chemical Equipments*

At present in Russia act about 30 enterprises (Ural, Ruzhev, Morshansk, Penza plants of chemical machinery, Moscow and Kazan' compressor plants, Neftekhim-mash and others) producing chemical and petrochemical equipment. Some enterprises of chemical machinery cancelled their work work.

Major portion of the equipment is produced according to old projects, it does not have guarding documents, certificates of safety, systems of service and operational maintenance. Without the technical reequipping of the petrochemical sector enterprises the reorientation of the branch to the deep processing of raw material is impossible. Imported technologies are

frequently inaccessible and expensive (especially this concerns the newest, highly effective equipment).

#### *The Specialists Body is Deficient*

For a long period were used the personnel of the skilled workers and engineers prepared before the economics reformation. At present the system of the personnel for the petroleum chemistry preparation and retraining, the especially of middle level, is destroyed. A quantity was reduced and changed the qualitative composition of scientific workers in the branch scientific and designing organizations. Personnel body becomes older while the conditions for attraction and fixing young specialists in the majority of scientific organizations is absent. With this situation it is extremely difficult to provide the personnel reproduction.

#### *Ecological Situation*

Petrochemical industry is a source of strong environment pollution. By the ejections of harmful substances into atmosphere the petroleum chemistry occupies the tenth place among the branches of industry, by the discharges of effluents into the natural reservoirs the second place. The ejections of petrochemical enterprises into the atmosphere are about 400 thousand ton yearly. The basic atmosphere contaminators are light organic compounds, whose portion in the ejections reaches 20%. Especially unfavorable situation with ejections in the enterprises of joint stock companies "Nizhnekamskneftekhim" and "Angara Petrochemical Plant."

By the level of the use of the available water resources the petrochemical industry anticipates ferrous and nonferrous metallurgy, being inferior only to electro-energetics. The substantial part of the water is used in the technological processes, which leads to the pollution of effluents.

Yearly in the enterprises of the branch are formed about 15.0 mln. ton of toxic substances (without taking into account the withdrawals of 5-th class), first of all these are petroleum sludges, from which are rendered safe only about 20% of substances. The liquidation of withdrawals is hindered by the absence of the profitable technologies of their processing. The classification of production wastes is not completed. At present acts the system that assigns withdrawals to the classes of chemical compounds, while the majority of withdrawals are of mixed composition.

Developed by the number of companies the program of ecological measures on 2004–2010 years can not

solve all connected with petrochemical enterprises ecological problems of cities and regions without the state support.

It is obvious that the matched efforts of state and private business are necessary for the solution of the systemic problem of the petrochemical complex of Russia, *the package of measures of industrial policy is necessary*. An indicator of the solution of problem is increase of the most important products per capita: plastics and synthetic resins, synthetic fibers and threads, synthetic rubbers and latexes. The producing per capita of plastics and synthetic resins in 2015 is forecast not less than 68.0 kg, synthetic fibers and threads not less than 5.0 kg, synthetic rubbers and latexes not less than 14.5 kg.

Strategy considers two versions of the petrochemical complex development: inertial (passive) and innovation (active).

The inertial scenario in the absence of the decisive and scale investment projects will lead to the fact that in the course of time practically entire production of petrochemical complex will be noncompetitive. Especially this concerns synthetic fibers and threads (–61%), polypropylene (–41%), polyethylene (–37%), polystyrene (–24%), polyvinyl chloride (–2%). Sharp reduction in the competitiveness is connected, first of all, with an increase in the prices of the raw material and energy resources. Inertial scenario will lead already in 2011–2012 years to stagnation of Russian petroleum chemistry, to the displacement of domestic companies from the internal and external markets, to the loss of scientific potential. It is obvious that with this scenario is unacceptable for the state and Russian business.

The innovation scenario is based on a scale increase in the investments, technological modernization of production, introduction resource and energy-saving technologies and producing new highly technological materials. The compensation for the negative consequences of an increase in the prices of the raw material and the energy resources is ensured by an improvement in the quality of production and by a reduction in its prime cost due to the technological renovation of enterprises and introduction of new technologies. This way assumes attraction of direct foreign investments, the purchase of licenses to the highly effective newest technologies, the concentration of innovation activity on development and introduction of wasteless technological processes with the limited



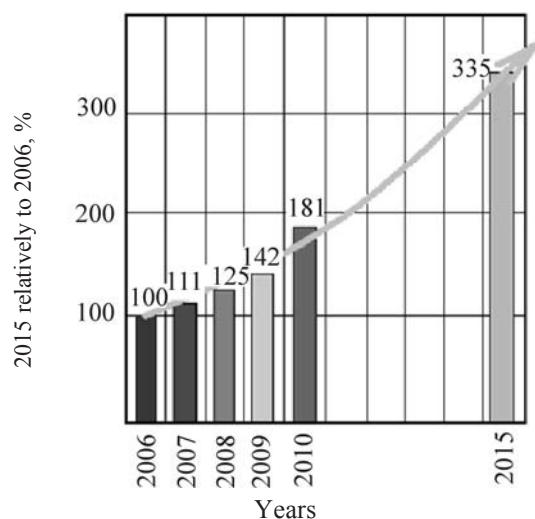


Fig. 6. Forecast of the development of the chemical complex of Russia.

quantity of operations and the deep transformation of raw material. The development of nano-chemistry, which integrates the latest achievements of physics, chemistry and biologies, is assumed.

Within the framework of the innovation scenario is expected an essential improvement in the financial and economic state of the enterprises of petrochemical complex during years 2010–2015. The dynamics of the development of Russian chemical complex according to the innovation scenario is given in Fig. 6.

### The Method of the Realization of the Strategy of Development

The innovation scenario will make it possible to increase the products quality to the world standards and providing successful competing with the foreign producers. Russian science and technology will obtain new pulse of development. In Fig. 7 and 8 are given basic indices and purposeful indicators of innovation strategy.

*The realization of innovation scenario* provides stimulation of investments into the petrochemical industry on the basis of private–state partnership; increase in the technical and economic level due to the reconstruction, modernization and creation of new facility; an increase of the sector of production with the high gross value addition; reduction in the specific consumption of raw material, fuel, energy and labor resources; the development of the import replacing

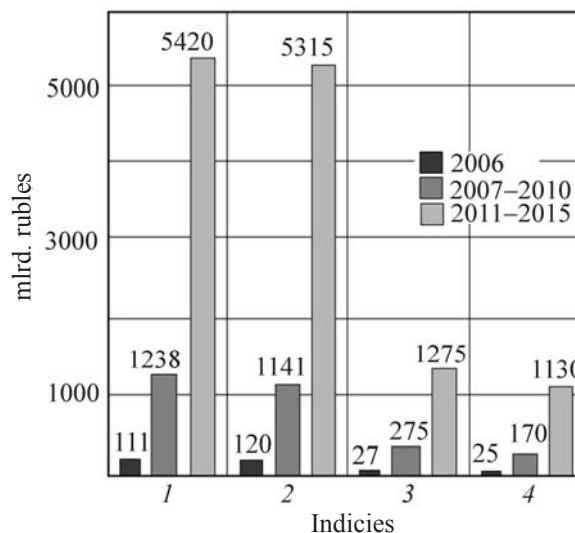


Fig. 7. Basic indices of the innovation scenario of the development: Along the x axis: (1) profit from the carrying out of production (goods, works, services); (2) summary profit priorly the taxation; (3) budget income; (4) fixed asset formation.

productions; the deepening of processing hydrocarbon raw material on the basis of the newest technologies, including effective use of following oil gas; the maximum introduction of the results of domestic developments and the use of the newest equipment of domestic machine-building enterprises with the reconstruction, the technical reequipping and the building of new productions.

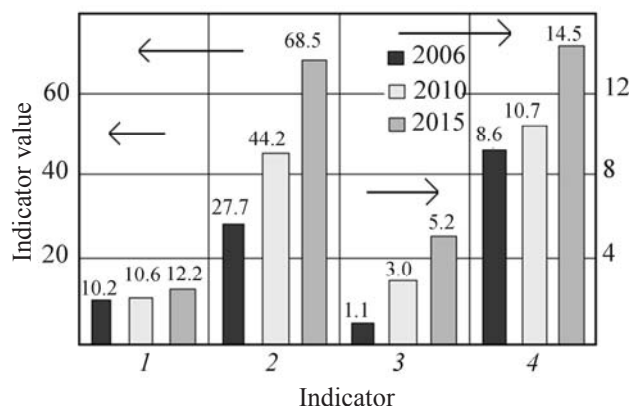


Fig. 8. Basic indicators of the innovation scenario of the development: (1) sector of chemical complex in total volume of manufacturing industry production; (2) production of synthetic resins and plastmasses; (3) production of chemical fibres and filaments; and (4) production of synthetic rubber.

**Table 3.** Forecast of the production of heat-power engineering complex of Russia (mln. ton)

Designation	2006	2007	2008	2009	2010	2015
Oil mining	480	490	495	499	503	515
Including gas condensate	18.4	18.5	19.0	19.5	20.0	22.5
Primary petroleum refining	220	228	229	230	232	240
Gasoline fractions	47.5	49.7	50.6	52.1	53.3	58.2
Including direct distillation gasoline	13.2	13.7	13.7	13.8	14.0	14.8
Natural gas, billion cubic meters	656	665	677	697	707	814

It is assumed creation of the integrated structures, which include profile research institute and design bureau, the producers of complete plant equipment for the concrete technological productions, which accomplish delivery and service maintenance of the equipment. The introduction of ecologically safe technologies, automated systems of environment control and providing enterprises with the highly skilled personnel is necessary.

Following prerequisites and possibilities can provide realization of the innovation scenario of the Strategy.

(1) *Presence of the large corporate structures*, capable of organizing independently manufacturing of competitive petrochemical products and of wide network of the enterprises of the small and mid-sized business. The stably functioning large corporations includes “Sibur Holding” (“Sibur” group); holding company “EvroKhim”; group “Lukoil-Neftekhim,” “Tatneft,” “Tatneftekhiminvest- Holding”. To the number of important companies should be also assigned joint stock companies “Nizhnekamskneftekhim,” “Salavatnefteorgsintez,” holding company “Akron,” “Tolyattiazot,” “Ufaneftekhim,” “Kazanorgsintez,” “Sayanskkhimpplast,” company “Kuybyshevazot” and some others.

The formation of scientific and industrial structures has special urgency for the petrochemical complex, beginning from mining and processing hydrocarbon raw material to the release and supplying to market of the product of high transformation.

(2) *Presence of own Russian hydrocarbon raw material*. By the recognized reserve and mined natural gas Russia occupies the first place in the world, by oil production occupies second position. Resource base for the petrochemical production is capable of ensuring the innovation version of development. In Table 3 is given the forecast of the production of fuel and energy complex of Russia until 2015.

In Table 4 is given the forecast of the demand of chemical complex for the hydrocarbon raw material. At present a number of decisions is accepted on the government level on the utilization of the oil associated gas, and on the acceleration of the oil refineries modernization and stimulation of deep petroleum refining.

(3) *Promotion and increase in the effectiveness of the investment process* depends on number of the factors: an increase in the profit of petrochemical complex, adequate strategic planning, development of financial market, support from the side of state and others.

The significant volume of investments to the petrochemical complex has been already obtained as a result of associations of enterprises and formation of the large energetic companies, “Gazprom” and “Lukoil.” Concentration of capital in the important vertical-integrated companies in account of “horizontal integration” of medium-sized and small ones will contribute to the accumulation of powerful financial funds and to increase in the effectiveness of investment activity. Key value has a readiness of companies to invest into the modernization of the already existing facilities and into the creation of new ones (Table. 5).

Under the conditions of the increased investment activity special importance acquires strategic planning, the competent policy with respect to the assortment structure of investments, which prevents the over-production of the identical products.

(4) *In the territory of Russia there are large petrochemical units*: correlated manufacturers with the industrial-technological connections and the general infrastructure (cleaning facilities, heat and power stations, water intakes, transport, etc). As a whole, the prevailing territorial arrangement of the branches of petrochemical industry predominantly in zones and subjects of the European part of Russia will be preserved. Volga federal region will remain the basic and largest region of petroleum chemistry. Here will

**Table 4.** Chemical complex demand for hydrocarbon raw material, thousands ton

Hydrocarbons	2005	2006	2015		2015 relatively to 2005, %
			Inertial scenario	Innovation scenario	
Gas fractions, totally	7041	7158	11184	12405	159–176
Including:					
direct distillation	6450	6566	10255	11375	159–176
of that for producing aromatic hydrocarbons	3634	3736	5790	6464	159–178
of that for pyrolysis	2816	2831	4465	4910	153–174
Gas hydrocarbon liquefied, totally	3506	3599	6178	6857	176–196
Including:					
propane fraction	144	163	660	781	458–542
propane-propylene fraction	450	469	759	885	169–197
propane-butane fraction	307	341	913	980	297–319
butane fraction	1758	1790	2541	2806	145–160
isobutane fraction	655	670	954	1033	146–158
other liquefied fractions	193	165	351	372	182–193
Isopentane fraction	466	481	731	829	157–178
Wide fraction of light hydrocarbons (pyrolysis)	684	673	1022	1259	149–184
Ethane	297	321	1684	2120	567–714
Natural gas (mln m <sup>3</sup> )	19942	20611	24817	27511	124–138

be used increasingly petroleum-gas raw material from the Ural and Siberia. Increase in Tatarstan and Bashkortostan, Permian kray, Samara, Tomsk and Nizhniy-Novgorod regions and others is planned, with the retention of the production specialization. A new polymer producing plant in the Ural federal region is planned.

Provision is made for the consumption of gas for the gas based chemical manufacture in East Siberia of the volume 6.6 billions m<sup>3</sup> in 2020 and 2030, in the Far East region of the volume 7.0 billion. m<sup>3</sup>.

The introduction of the new oil-gas-chemistry complex is planned in East Siberia since 2017; in the Far East not earlier than 2020. Provision is made for the creation of gas-chemical complexes in Krasnoyarsk region, in the Republic of Saha (Yakutiya), and also the reconstruction of Angara and Sayan petrochemical plants. Within the framework of the strategy is forecast the beginning of the ethylene, vinyl chloride and polyvinyl chloride manufacturing in 2012; ethylene glycol in 2013. and propylene in 2015.

Special study require development of petroleum chemistry in the Far-Eastern federal region on the base of the deep processing of the hydrocarbon raw material of the Okhotsk Sea shelf (Sakhalin island). In this case not only the demand for the production of polymeric chemistry in the eastern regions of the country can be satisfied, but also will be intensified the export potential of the region.

*State of Some Directions in Scientific and Technical Development*

According to the situation in 2006, in the chemical and petrochemical industry there are 53 scientific research organizations including 24 Federal State Unitary Enterprises and 29 joint-stock companies. Scientific studies and developments in the field of chemistry and petrochemistry perform the profile institutes of Russian Academy of Science and departments of Higher Education institutions, the scientific subdivisions of large vertically integrated structures and central laboratories of individual enterprises.

**Table 5.** Projects in the field of the production of polymeric materials (thousand ton)

Project	2007	2008	2009	2010	2011–2015
Polyethylene					
Kazan'orgsintez	95	30	120	–	–
Tomskneftekhim	30	–	–	–	–
Nizhnekamskneftekhim	–	230	–	–	–
Astrakhan' gas workup plant	–	–	–	–	300
Enterprise in Samara region	–	–	–	–	200
Polypropylene					
Stavrolen	120	–	–	–	–
Astrakhan' gas workup plant	–	–	–	300	–
NOVATEK	–	–	–	–	200
Polyvinylchloride					
Kaustik, Sterlitamak	–	–	–	40	50
Sayanskkhimplast	–	–	–	–	350
Sibur-Neftekhim	–	–	–	–	330
Khimpromsol'e	–	–	–	–	120
Polyethyleneterephthalate					
Sibur-Polyethyleneterephthalate, Tver'	30	–	–	–	–
Snezh, Moscow region	–	10	110	–	–
POLIEF, Bashkortostan	120	–	–	–	–
Nizhnekamskneftekhim	–	–	–	–	250
Enterprise in Kaliningrad region	–	–	240	–	–
Polycarbonate					
Kazan'orgsintez	65	–	–	–	–

Some scientific associations have innovation developments at the level of world achievements. Analysis of approximately 400 innovation projects showed that more than half of them (57%) were protected by RF patents and some by the patents of the leading foreign countries; 53% of project are directed toward the development of new technologies, 36% for the creation of principally new products, and 11% for the development of new equipment.

For increasing the effectiveness in the scientific research and designing is necessary strengthening the contact between scientific organizations and enterprises, focusing the efforts of several groups on the solution of promising practical problems, creation

of favorable lawful and economic conditions for the development of small enterprise and marketing innovation products; optimization of the expenditures of enterprises for the development of projects; creation of favorable conditions for attracting young specialists into the scientific and technical sphere.

The mechanisms of the realization of innovation policy include concentration of resources for the output of innovation products; creation of scientific-technological centers with the attraction of the private capital; formation of financial-credit infrastructure for the purpose of complex support to innovation activity; collaboration with the leading higher educational institutions, creation of instrumental parks.



The strategy realization will make possible to increase the release of goods, works and services in 2015 as compared with 2006 3.3 times, which will give in the prices of the given year of 4729.5 billion rubles (152.1 billion dollars USA); to increase the portion of chemical production in 2015 to 12.2% of the processing industry product. It is planned to increase the production of the most important forms of materials per capita of population and to enlarge its assortment (by 20-25% for the composite materials from the basic polymers, complex mineral fertilizers, synthetic fibers and threads), to increase the volume of the production export by 44.2% in 2110 and by 60.2% in 2115 as compared with 2005. Import in 2015 as compared with 2005 of synthetic detergents will decrease from 12.9 to 9.0%; of plastics and the synthetic resins from 26.8 to 10.0%; of synthetic fibers and threads from 59.7 to 34.0%; paints from 33.7 to 26.9%; plastic products and components from 21.6 to 14.0%; plastic products of every day use from 16.3 to 6.0%; thermoplastic sheets from 49.4 to 14.0%; polymeric containers and packaging materials from 16.1 to 10.0%; pipes and pipe line parts made of thermoplastics from 24.6 to 11.0%.

In 2015 an increase in the production will comprise (% to 2005): automobile tires 155.7; synthetic rubbers and latexes 175.9; plastics and synthetic resins 268.9; plastic products and parts for industry 194.9; plastic products of every day use 205.9; thermoplastic sheets 396.7; polymeric films 237.4; polymeric containers and packaging 174.9; pipes and pipe line parts made of

thermoplastics 445.7; glass-fiber reinforced plastics and goods of them 214.9.

Strategy intends to bring the specific weight of the technologies of world level to 30–50%, to increase the volume of the industrial production produced with the resource-saving technologies to 20–25% and to ensure the requirements of ecological safety in accordance with the technical regulations “Safety of chemical production.” The use of hydrocarbon raw material is planned to increase in 2015 twice compared to 2005; including ethane 7.1 times, straight distillation gasoline 1.8 times, the liquified hydrocarbon gases 2.0 times.

### CONCLUSION

Realization of strategy will make it possible to weaken the dependence of the economy of the country on the import of science-intensive production, to enlarge highly technological export; to increase tax revenues into the budget of Russian Federation and export gain.

The market demand for the chemical and petrochemical production will be provided; the effective market business structures of new generation will be formed; innovation activity and level of the renovation of the fixed capital for enterprises in the chemical and petrochemical industry and adjacent fields will increase. Demand for the qualified scientific and technical personnel will increase and the draining of scientific and technical personnel will decrease.