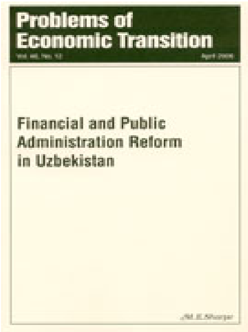

Problems of Economic Transition

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Russian Chemistry

Moving Forward or Running in Place?

Russia is far from the top place in the world among industrial countries in production and consumption of polymers and other types of chemical products. Why is chemistry in our country unable to develop as fast as, for example, in China? We are moving forward at a rate that is hardly more than the world average—that is, we are not actually making any progress, and what is the reason for this? Can the situation be fixed, and how can it be done?

[Part 1]

Why a lot of oil, and not a lot of petrochemicals?

The current situation in the chemical industry (including petroleum and gas chemistry) in Russia is disappointing and puzzling at the same time. The country that has the largest hydrocarbon reserves in the world and is the world leader in hydrocarbon production and exports is almost in the back row of

"Rossiiskaia khimiia: dvizhenie vpered ili beg na meste?" Part 1: *EKO,* 2010, no. 7, pp. 55–75; Part 2: *EKO,* 2010, no. 8, pp. 44–63.

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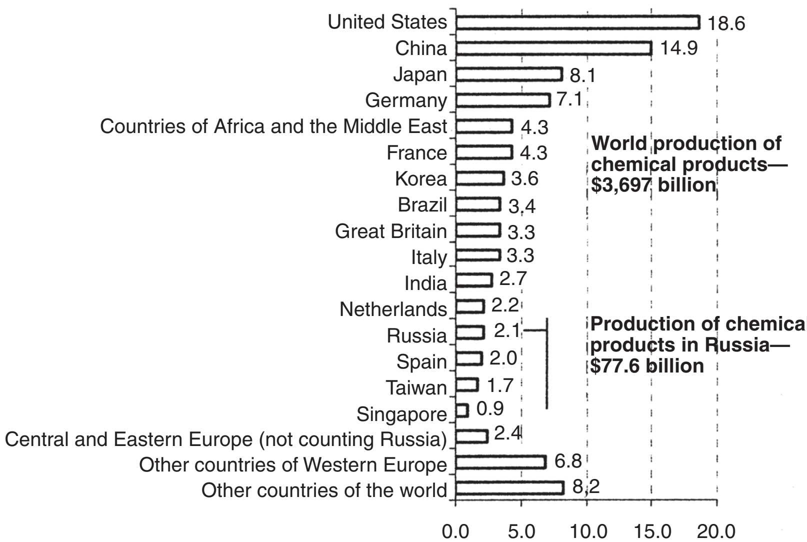
Translated by James E. Walker.

Notes, tables, and figures renumbered for this edition.—Ed.

Figure 1. **Shares of World Production of Chemical Products in 2008** (%)



Source: Data from the American Chemical Council; available at www.americanchemistry.com.

the international chemical industry. According to various estimates, Russia's share of international output of chemical products is 1–2 percent (Figure 1). The Soviet Union was behind only the United States and was the world leader in output of certain types of chemical products (e.g., synthetic rubber).

In the ratings of countries that produce chemical products today, Russia is behind not only the United States, but all large countries of Western Europe, as well as Japan, China, Korea, India, Brazil, and Saudi Arabia. We are at approximately the same level as the countries of Eastern Europe, Spain, and the Netherlands, and slightly ahead of Belgium, Ireland, and Switzerland. As for Asian competitors, Taiwan and Singapore are breathing down our neck.

All of this is frequently explained by the fact that after the collapse of the Soviet Union Russia was left with the larger, but by no means the better, part of the Soviet chemical industry. Therefore, the structure of the Russian chemical industry in the first half of the 1990s was like that at the beginning of industrialization.[1]

During the time of the planned economy, the Russian Soviet Federative Socialist Republic specialized in production of the most resource-intensive

Table 1

Production of Basic Types of Chemical Products in the Soviet Union in 1990 (1,000 tons) **and the Russian Federation's Share** (%)

Product	Soviet Union	Russian Federation	Russian Federation share, %
Mineral fertilizers, total, million tons	31.7	16.0	50.4
Nitrogen	13.2	7.2	54.4
Phosphate	9.5	4.9	52.0
Potash	9.0	3.8	42.8
Chemical plant protection agents	205.0	111.0	54.1
Methanol	3,233.0	2,508.0	77.6
Sulfuric acid, million tons	27.3	12.8	46.9
Soda ash	4,359.0	3,240.0	74.3
Caustic soda	2,974.0	2,258.0	75.9
Synthetic resins and plastics	5,536.0	3,258.0	58.9
Chemical fibers and filaments, total	1,477.0	673.0	45.6
Artificial	522.0	357.0	68.4
Asynthetic	955.0	317.0	33.2
Synthetic detergents	1,503.0	876.0	58.3
Paints and varnishes	3,543.0	2,338.0	66.0
Tires, million	68.2	47.7	69.9
Synthetic rubber	2,168.0	1,610.0	74.3

Sources: Narodnoe khoziaistvo SSSR v 1990 g. Statisticheskii ezhegodnik (Moscow: Financy i statistika, 1991); Federal State Statistics Service, Central Statistical Database; available at www.gks.ru/dbscripts/Cbsd/KBInet.cgi; *Nauka i vysokie tekhnologii Rossii. Na rubezhe tret′ego tysiacheletiia*.

chemicals, in which material costs dominated production costs, since it was precisely in the territory of Russia that the largest raw material and energy resources necessary to produce chemical products were concentrated. In 1990, the Russian Federation accounted for 33–78 percent of the Soviet output of basic types of chemical products (Table 1). Its share of production was highest for basic chemistry, petrochemical intermediate products, and synthetic rubber (75 percent or more), and lowest for final types of chemical products (plastics, synthetic fibers, chemical plant protection agents, mineral fertilizers, etc.—30 to 60 percent).

On the whole, the Russian Federation accounted for about two-thirds of the Soviet Union's production of chemical products, and more than half of the chemical enterprises were in its territory (60 percent of industrial production assets, 61.5 percent of industrial production personnel, and 70 percent of the sector's research and design facilities).[2]

But this explanation is flimsy. Russia inherited at least 60 percent of the production, scientific, and technical potential of the Soviet chemical industry (including a number of relatively new production facilities and enterprises). So why has this potential not been developed and augmented in the past two decades?

The simple version of the answer is that the chemical industry suffered the same fate in post-Soviet times as did other manufacturing sectors. It is sufficient to recall our auto industry, electrical engineering industry, consumer-goods sectors, and others that have suffered so much. But these manufacturing sectors were de facto uncompetitive back during the time of the planned economy. So after our borders were opened for imports, foreign machine-building and high-tech products easily displaced most Russian manufacturers from the domestic market. On the whole, even in spite of its frequently obsolete technologies, the Russian chemical industry was quite competitive in the domestic market and even in the foreign market for many goods. Russian chemistry had an indisputable advantage over leading foreign producers in price competition (and still does, to some extent) because of the relatively low domestic prices for feedstock and energy resources.

Two main reasons explain the Russian chemical industry's failure to grow in the 1990s and its excessively slow growth in the 2000s:

1. the sharp drop in domestic demand as a result of the deep transformation crisis, which affected the whole domestic economy and the consequences of which have not yet been overcome;
2. the impact of institutional factors: the abandonment of strict government planning and control in a vacuum of market regulating tools, privatization, division and redistribution of ownership and spheres of influence, monopoly trends, and other such disturbances.

While institutional factors can relatively easily be tuned to a stimulating key (which requires a certain political will on the part of the government), it is much harder to overcome demand constraints. Doing so requires not only acceleration of the country's socioeconomic development but also serious structural reform and a significant change in growth factors. This is the hardest part of a complex task, accomplishment of which apparently has to start with overcoming the inertia of economic thinking and views of the chemical industry's role and place in the Russian economy.

We consume less than we produce

No one now denies the need for rapid development of the chemical industry, but this point of view peacefully coexists with the opinion that we do not need as many chemical products as other industrially developed countries do. They say that a different structure of consumption of materials (including building materials) has taken shape in the Russian economy, with a high percentage of metals, wood, and other natural raw materials. But all this means is that today we have a structure of material consumption that is just as archaic as it was in the 1960s, when the issue of creating our own strong polymer chemistry in the Soviet Union was a critical one.

One of the main arguments in favor of chemization [increasing the use of chemicals and chemical methods of processing in the economy] was and still is that in the consumption sphere, 1 ton of plastics replaces, on average, 5–6 tons of ferrous metals and 2–2.5 tons of aluminum, 1–12 tons of natural fibers, and up to 25 cubic meters of merchantable wood, and that the waste from plastics processing averages 5–10 percent—approximately five times less than from metals processing, and so on, and so forth.[3] And this does not even take into account that in past decades, first, the price ratios between natural and artificial materials have changed in favor of the latter, and second, that a great many new types of chemical products have appeared (primarily polymers) that have no direct natural equivalents.

Unfortunately, it is hard even to compare the per capita indexes for production and consumption of the basic types of chemical products in Russia and developed countries. For example, average per capita production of five basic polymers in Russia is about 21 kilograms, which is 25 percent of the production in West European countries (Table 2). Average per capita consumption of polymer materials in Russia is around 24.7 kilograms, which is commensurate with the figures for China (with its population of 1.3 billion people!) and Brazil, but much less than, for example, in Great Britain (47.6 kilograms per person), not to mention the United States (77.6 kilograms per person).

At present, Russia is ahead of West European countries only in the production of synthetic rubber, methanol, and mineral fertilizers—Russia's main chemical export. Therefore, even when leading in production, Russia lags considerably behind developed foreign countries in consumption level. For example, we apply mineral fertilizers to the soil (per unit of planted areas) at a rate an order of magnitude less than in West European countries and three to four times less than in Canada. Accordingly, the yield of agricultural crops in Russia is approximately one-third of that in the Netherlands and Great Britain, and one-third less than in Canada.[4]

Table 2

Per Capita Production of Chemical Products in 2008 (kg)

Type of product	Russia (1)	Western Europe (2)	Ratio (1/2)
Polyethylene	9.9	29.0	0.34
Polypropylene	4.2	21.8	0.19
Polyvinyl chloride	3.7	14.8	0.25
Polystyrene	1.8	5.8	0.31
Polyethylene terephthalate	1.9	5.5	0.35
Ethylene glycol	1.6	4.5	0.36
Chemical fibers and filaments	1.1	10.3	0.11
Synthetic rubber	6.7	5.0	1.34
Methanol	16.1	6.5	2.48

Sources: S. Kim, "Srednedushevnoe otstavanie," *Chemical Journal*, 2010, no. 3, pp. 46–49; "Facts and Figures: The European Chemical Industry in a Worldwide Perspective: 2009," CEFIC Report (Brussels: European Chemical Industry Council, 2009).

In its use of mineral fertilizers in agriculture, Russia is currently at about the level of the mid-1970s, which is less than half as much as the per hectare figure in 1990 (Table 3). Our agrarian complex has begun to climb out of the hole only in the past three years, when, along with an increase in the use of fertilizers, more or less appreciable growth of the yield has been noted in crop production. However, if we look at the trends of figures during this almost forty-year period, then the familiar Russian saying "it's a waste of good food" comes to mind.

We can conclude from this that the efficiency of using fertilizers in agriculture—in the form of increased yield—depends not only on the quantity of nutrients applied to the soil but also on many other factors (technologies, breeding, etc.).

A sad picture, but one quite common for the Russian economy, can be seen in the sphere of production and use of synthetic rubber. In the past few years, this subsector of petroleum chemistry has begun to gradually climb out of the hole into which it fell at the beginning of the 1990s. In 2008, Russia was fourth in the world (after the United States, South Korea, and Japan) in synthetic rubber exports. It would seem that things are not so bad, but, while selling synthetic rubber, which is actually an intermediate product, abroad for $1.8 billion, we import tires for $1.4 billion.[5] This proves, once again, that the processing of polymer materials to produce a final product (even if

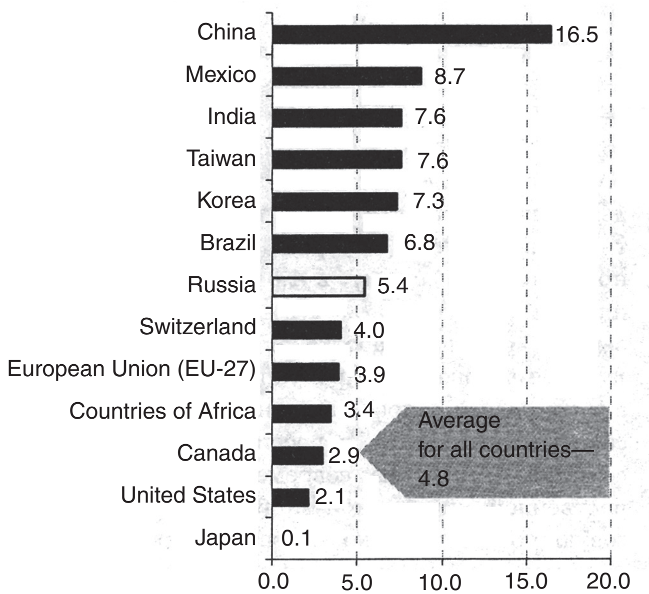
Table 3

Application of Mineral Fertilizers to Planted Areas and Yield in Russian Agriculture in 1970–2008

Parameter	1970	1980	1990	1995	2000	2005	2006	2007	2008
Mineral fertilizers applied:									
Total, million tons	3.3	7.5	9.9	1.5	1.4	1.4	1.5	1.7	1.9
Per hectare of planted area, kg	28	62	88	17	19	25	27	32	36
Percentage of area with mineral fertilizers applied over the whole planted area	36	58	66	25	27	32	34	39	44
Average yield of grain and legume crops, centners/hectare	12.9*	13.8*	16.5*	15.7*	15.1*	18.8*	18.9	19.8	23.8

Source: Rossiiskii statisticheskii ezhegodnik: 2009. Statisticheskii sbornik (Moscow: Rosstat, 2009), p. 414.
*On average for the five-year period ending in the year indicated.

Figure 2. **Average Annual Growth Rate of Chemical Product Sales in 1997–2007 by World Regions and Countries** (%)



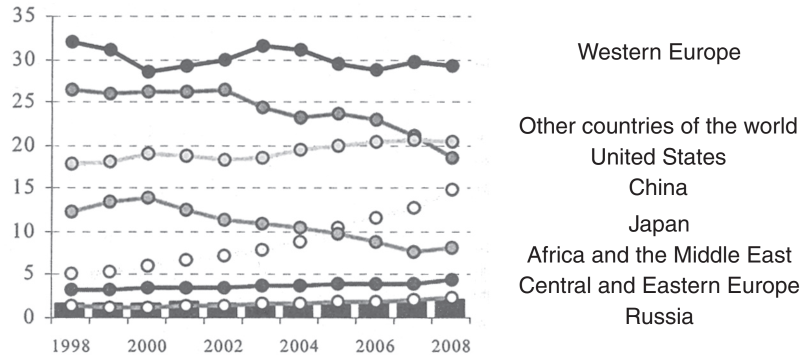
Source: "The Future of the European Chemical Industry," KPMG International, 2010; available at www.kpmg.com.

there is considerable demand for it in the domestic market) is a bottleneck in the Russian chemical complex. Sadly, in the current stage of development of the domestic chemical industry (including foreign-trade policy) there is obviously not enough healthy pragmatism, in contrast, for example, to the Chinese chemical industry.

The subject of China cannot be avoided

When speaking of the problems chemical industry development in Russia, it is hard to overlook the subject of China. And the point is not only that to our envy—and that of many other countries of the world—in the past twenty-five to thirty years China has consistently demonstrated simply fantastic growth rates of its chemical industry, not unlike those that took place in the Soviet Union in the 1950s and 1960s. These rates have been more than three times higher than the international average (Figure 2). The "Chinese factor" now determines changes in the international chemical rankings, and the time is not far off when the Celestial Empire will pass the United States and become the absolute world leader in output of chemical products (Figure 3).

Figure 3. **Changes in International Chemical Rankings in 1998–2008**
(shares of countries and regions in international production, %)



Source: Data from the American Chemical Council; available at www.americanchemistry.com.

It is also noteworthy that the main impetus for the development of chemistry in China (in contrast to almost all other new industrial countries) is increased domestic market demand, rather than expanded foreign trade. China today is one of the largest international importers of chemical products, in third place after countries of the European Union (EU-27) and the United States (Table 4). But, in contrast to West European countries and the United States, China has a substantial negative balance of foreign trade in chemical products ($36 billion in 2008). *In other words, China's rapidly growing chemical industry is not keeping up with the growth of domestic demand.*

The same can be said of the situation that is taking shape in the Indian chemical industry. In contrast to China and India, the development of the chemical industry in countries of the European Union and Japan, as well as in Korea and countries of the Middle East, is largely aimed at exports.

Unfortunately, Russia's position looks quite weak. On the one hand, we have the highest dependence on imports (almost 35 percent in relation to our own output) and a considerable negative balance of foreign trade in chemicals. On the other hand, the proportion of exports in our output is very high (only Korea and countries of the Middle East have a higher proportion), which indicates a serious disparity of demand and production within the country. Dominating the production mix are resource-intensive, primary processes that produce relatively simple products (mineral fertilizers, petrochemical intermediate products, basic polymers) directly associated with the available feedstock resources. Demand is increasingly shifting to complex, expensive

Table 4

Output, Exports, and Imports of Chemical Products for Some Regions and Countries in 2008

Region, country	Production		Exports*			Imports**			Balance of exports/ imports
	Billion dollars	% of total	Billion dollars	% of total	% of output	Billion dollars	% of total	% of output	
European Union	1,077	29.1	301	16.9	28.0	200	10.7	18.6	101
United States	689	18.6	190	10.7	27.6	198	10.6	28.7	–8
China	549	14.9	90	5.1	16.4	126	6.8	23.0	–36
Japan	298	8.1	77	4.3	25.8	48	2.6	16.1	29
Korea	133	3.6	48	2.7	36.2	37	2.0	27.8	11
India	98	2.7	22	1.2	22.3	34	1.8	35.0	–13
Middle East	120	3.3	45	2.5	37.7	38	2.0	31.5	8
Russia	78	2.1	25	1.4	31.3	29	1.6	37.8	–4
World as a whole	3,697	100.0	1,781	100.0	48.2	1,863	100.0	50.4	—

Sources: 2008 International Trade Statistics Yearbook; available at http://comtrade.un.org. Data from the American Chemical Council; available at www.americanchemistry.com.
*In FOB prices; **in CIF prices.

Table 5

Volumes and Structure of Russian Foreign Trade in Chemical Products in 2008

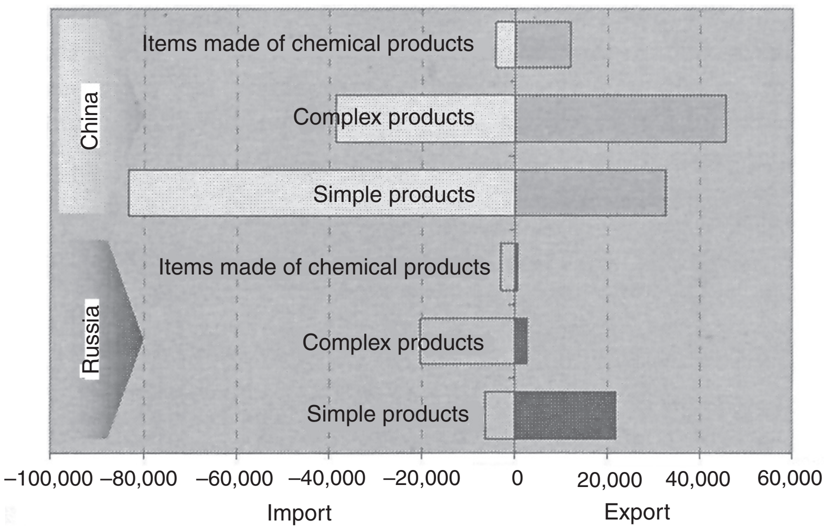
Product	Exports		Imports	
	Billion dollars	% of total	Billion dollars	% of total
Petrochemical intermediate products	2.4	9.6	—	—
Synthetic rubber	1.9	7.4	—	—
Basic polymers (including processed ones)	1.9	7.7	4.6	15.7
Inorganic chemical products	3.7	14.7	1.6	5.3
Mineral fertilizers	11.8	47.4	—	—
Complex petrochemical products	1.5	6.0	1.5	5.2
Paints and varnishes	0.1	0.5	2.0	6.9
Pharmaceutical chemicals	0.3	1.0	9.2	31.4
Perfumes and cosmetics	0.4	1.5	3.0	10.3
Synthetic detergents	—	—	0.7	2.5
Engineering plastics	—	—	0.9	3.0
Plastic plumbing products	—	—	0.6	1.9
Plant protection agents	0.1	0.3	0.5	1.8
Tires	0.7	3.0	1.4	4.9
Industrial rubber products	—	—	0.9	2.9
Other chemical products	0.2	0.9	2.4	8.2
Total	25.0	100.0	29.3	100.0

Source: 2008 International Trade Statistics Yearbook; available at http://comtrade.un.org.

products (including pharmaceutical chemicals) and products for which various polymers are used.

It is no accident that Russia is now becoming one of the biggest international importers (in the Top 15 according to the UN statistics) of pharmaceutical chemical, perfume and cosmetics, and paint and varnish products, tires, complex petrochemical products, plant protection agents, chemical fibers (including surgical thread), and plastic plumbing products. Altogether, these amount to almost 79 percent of imports of chemical products, while (in contrast, e.g., to Middle Eastern countries) we still also import approximately \$4.6 billion worth of basic polymers (Table 5). In the structure of exports,

Figure 4. **Distribution of Chemical Imports and Exports in Russia and China by Types of Products** (2008; billion dollars)



mineral fertilizers amount to 47 percent, and together with petrochemical intermediate products, the share of relatively simple types of products is close to 87 percent.

At present, Russia is taking approximately the same path as Middle Eastern countries with a wealth of oil resources. The only difference is that Saudi Arabia, the United Arab Emirates, or Kuwait are building up production and exports of basic petrochemical products much faster than we are, and they have competitive advantages (considering their level of hydrocarbon production costs and geographic location).

The difference between Russian and Chinese foreign trade in chemicals is striking. Relatively simple types of products dominate Chinese imports (66 percent in value terms), while complex products and items made of polymers dominate exports, with 64 percent (Figure 4). At present, China's imports of petrochemical intermediate products and basic polymers (including plastic scrap and waste) alone are worth approximately $70 billion, while it is the largest exporter in the world of tires ($8.7 billion in 2008) and synthetic dyes ($3.7 billion), as well as—which seems quite natural, if we take into account the country's raw materials base for chemical production—inorganic chemical products ($12.8 billion).

We mention an interesting detail: China's exports of polyethylene bags alone are worth $2.2 billion per year, and so are its exports of plastic figurines and other souvenir items.

The degree of integration of the national chemical industry into the system of international economic relations is impressive: China is currently in thirty-two out of thirty-eight Top 15 ratings of exporters of chemical products (number one in four cases) and in thirty-one of the ratings of importers (in first place in fifteen).[6] Russia's presence in the ratings is much more modest: ten and twelve times, respectively, among exporters and importers. And Russia is on top in only one rating: exporters of mineral fertilizers ($11.8 billion, or 16.6 percent of total world exports).

It may be said that China is now an active participant in shaping a new system for division of labor in the international chemical industry—a system that largely serves its own economic interests. The Celestial Empire's policy calls for both healthy pragmatism and precise calculation. Understanding that even a swiftly progressing national chemical industry cannot keep up with domestic demand, China mainly emphasizes the development of segments of the sector in which it is traditionally strong (inorganic chemistry) and the most promising ones that allow it to maximize the value of its products (output of complex products and finished items).

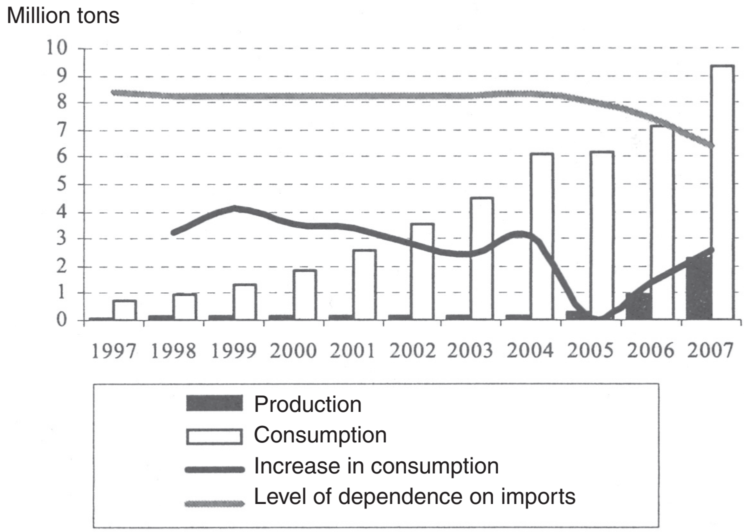
Importing basic petrochemical intermediate products and polymers is not too burdensome, considering that there are plenty of suppliers, whether they are oil-producing countries rapidly building their own muscle in the chemical industry, or nearby neighbors: Japan, South Korea, Singapore, Thailand, and others, even the United States. However, since 2005–6, China has gradually, but decisively, started to diminish its dependence on imports of polymers (Figure 5).

In contrast to China, which conducts an active foreign-trade policy, for a number of years recently Russia has simply reaped the fruits of the rise in international prices for primary energy resources (oil and gas), which led to a sharp increase in the prices of simple chemical products. This created the pleasant appearance of rapid growth of Russian chemical exports. But it turned out that the good fortune did not last long. The global financial-economic crisis dispelled the illusion: in 2009, following the drop in prices for energy resources, Russian chemical exports also declined, in value terms (Figure 6).

The leaders run faster than we do

Nothing remains but to regret that for almost two decades now the chemical industry in Russia has failed not only to come close to the Chinese growth rate, but even to appreciably exceed the world average. The growth rate that has been achieved means de facto that in reality we are making no headway, while

Figure 5. **Production and Consumption of Plastics in China in 1997–2007** (million tons)

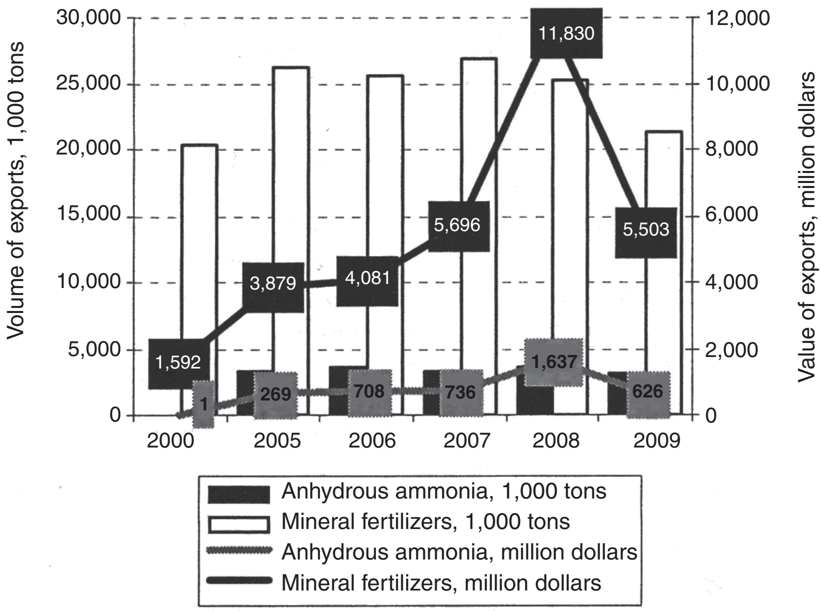


Source: KPMG International, "Chemicals in China: Responding to New Challenges" (2009); available at www.kpmg.com.

other countries—and there are quite a few of them, in addition to China—are getting ahead. As a result, the domestic chemical industry on the whole has barely reached the 1990 level. Of the major subsectors of the chemical industry, only three (the production of mineral fertilizers, synthetic resins, and plastics, and the processing of plastics) have been able to exceed the peak figures from the Soviet period (Figure 7). At the same time, several of the most important segments of Russian chemistry (the production of synthetic and artificial fibers, chemical plant protection agents, and paints and varnishes) have never even been able to rise up from their knees. Considering that production fell by 90–95 percent in some of these segments at the beginning of the 1990s, it may be said that *we have actually been deprived of whole subsectors of the chemical industry and now depend almost entirely on imports.*

We would especially like to point out that the current rivalry in the field of industrial chemistry (as in other high-tech sectors) and our place in it are, in the final analysis, an issue of survival in the complex contemporary world and an issue of the quality of economic growth and the efficiency of the country's socioeconomic development. In the immediate situation, this involves competitiveness and the struggle for markets. And if we lag farther behind our

Figure 6. **Physical Volumes and Value of Russian Exports of Simple Chemicals in 2005–2009**



Source: Data from Rosstat (Federal State Statistics Service. Central Statistical Database); available at. www.gks.ru/dbscripts/Cbsd/KBInet.cgi; and the RF Federal Customs Service; available at www.customs.ru.

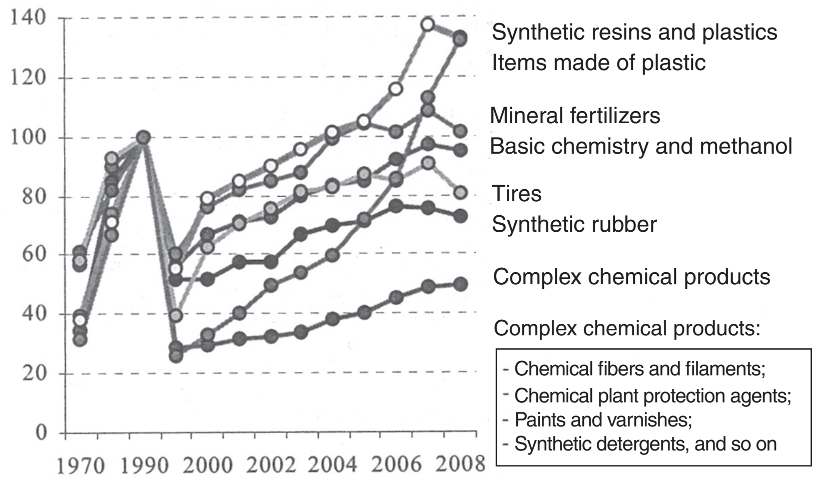
competitors, then we will lose not only our traditional export markets, not to mention winning new ones, but we will be forced to give up our own market.

The basic components of the success of all our competitors are technological innovation and a high concentration of production capacities, and in Middle Eastern countries, cheap hydrocarbon feedstock as well. And while attacks from Asian and Middle Eastern producers of chemical products are aimed primarily at the markets of China, Western Europe, and the United States today, *tomorrow the Russian market may become a similar target.*

The cumulative capacities of domestic chemical firms for many products (e.g., polyethylene, polypropylene, and ethylene glycol) are comparable in size with those of individual modern plants in Asia and the Middle East. As a result, all of Russia's chemical firms are no more than local players in individual regional or narrow product markets (mineral fertilizers).

As an example, we will look at the positions of Russian chemical companies

Figure 7. **Production of Basic Types of Chemical Products in Russia in 1970–2008** (1990 = 100; %)

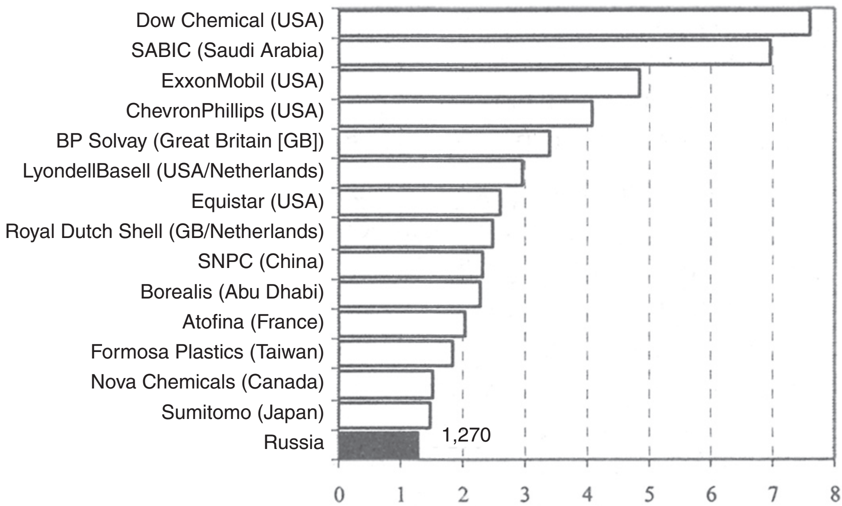


Source: Rossiiskii statisticheskii ezhegodnik: 2009. Statisticheskii sbornik (Moscow: Rosstat, 2009), pp. 398–401.

in production of the most common type of polymerization plastics: polyethylene. In 2008, the total world production of plastics was estimated at approximately 200 million tons, of which all grades of polyethylene accounted for 31 percent. Polyethylene production in Russia was 1.27 million tons (2.1 percent of the world total), and consumption was 1.46 million tons (2.4 percent of the world total). So the net imports were 0.19 million tons. In this case, total polyethylene output by all Russian companies was less than that for any of the world's fifteen largest producers, starting with the well-known American company Dow Chemical and ending with the Canadian company Nova or the Japanese one Sumitomo. In particular, among the largest producers are four rapidly growing companies from Asia and the Middle East (Figure 8). In these world regions, the annual commissioning of additional new capacities for producing polyethylene comes to millions of tons, far exceeding in size the existing capacities in Russia, and with growth rates an order of magnitude higher (Figure 9).

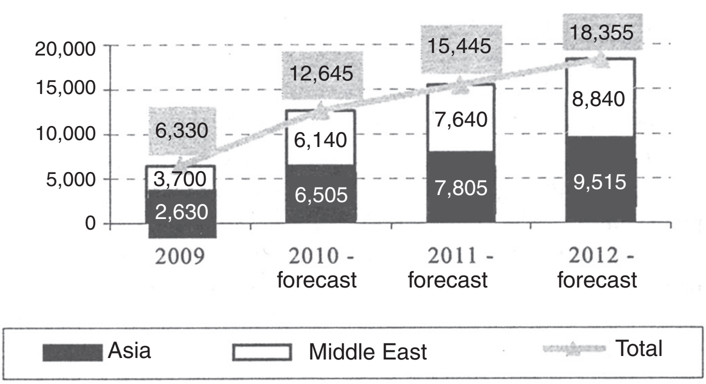
The overall picture clearly shows that as early as the near future the rapid growth of new producers may significantly change the alignment of forces in the international chemical elite. For instance, while in 2008 there were just two representatives of Asia and the Middle East among the ten largest chemical

Figure 8. **Comparison of Polyethylene Output in Russia and by the Largest Producers in 2008** (million tons)



Source: Data from Chemical Market Associates, Inc. (CMAI); available at (www.cmaiglobal.com) and producing companies.

Figure 9. **Commissioning of Capacities for Polyethylene Production in Countries of Asia and the Middle East in 2009–2012** (cumulative total; 1,000 tons)



Source: Data from Chemical Market Associates, Inc. (CMAI); available at (www.cmaiglobal.com) and producing companies.

Table 6

Largest Chemical Companies in the World in 2008 and Forecast for 2015

2008—actual	2015—forecast
BASF (Germany)—sales of $71.4 billion	SABIC (Saudi Arabia)
ExxonMobil (USA)	BASF (Germany)
Dow Chemical (USA)	Dow Chemical (USA)
Royal Dutch Shell (Great Britain/ Netherlands)	China National Chemical Corporation (China)
Ineos (Great Britain])	China National Chemical Corporation (China)
SABIC (Saudi Arabia)	DuPont (USA)
LyondellBasell (USA/Netherlands)	Reliance Industries (India)
China National Petroleum Corporation (China)	ExxonMobil (USA)
DuPont (USA)	International Petroleum Investment Company (Abu Dhabi)
Total (France)	Petrochemicals Industries Company (Kuwait)

Source: KMPG International, "The Future of the European Chemical Industry" (2010); available at www.kmpg.com.

companies, KPMG predicts that there will be six in 2015, from five different countries, not just China and Saudi Arabia (Table 6).

Once again, we must regret that in the foreseeable future (and not even in the very foreseeable future) it is unlikely that any Russian company will succeed in making it onto this leader board, for once again we have to compare incomparable quantities. Suffice to say that the sales of the largest chemical company in the world (BASF—$71.4 billion in 2008) are comparable with the value of the products produced by all of the Russian chemical companies.

[Part 2]

A race with hurdles

At present, the development of the Russian chemical industry is impeded by the following systemic problems.

- Characteristics of its fixed assets. Many of the sector's firms were built back in the Soviet era. Production capacities are oriented to domestic needs for basic chemical products: for the most part, the product assortment was established at the end of the 1980s and conforms less and less to the structure of either foreign or domestic demand. Moreover, from the start, the products did not meet international standards.

- Fixed production assets in the sector are 43 percent worn out, and a considerable part of them has been in operation for twenty years or more (for comparison, in the U.S. chemical industry the service life of equipment is no more than six years, on average).
- The sector's technical level does not meet contemporary requirements (obsolete technologies are characterized by high per unit consumption of raw materials and energy resources as well as a narrow assortment and low product quality).

As a result, the high-tech chemical products that the Russian market needs (plastic products, synthetic fibers and filaments, paint and varnishes, chemical plant protection agents, plasticizers, etc., not to mention pharmaceutical chemicals) are supplied from abroad. Thus, the systemic problem in the Russian chemical complex is a gap in development between the market and production spheres.

At present, Russia's chemical industry finds itself in a systemic technological crisis. The country does not have its own technologies for large-capacity production of almost any of the types of chemical products that can be obtained at least on the basis of hydrocarbon feedstock. This is true not only of complex polymers but also of the most common basic products, such as methanol, ammonia, polyolefins, and so on.

All of the large-capacity chemical facilities in operation in Russia (e.g., those at Tol′iattiazot and Tobol′sk Petrochemical Plant, and in Tomsk and Gubakha) were originally purchased abroad, but in the past twenty years the individual capacities of technological facilities for producing chemical and petrochemical products in the world have grown two to three times larger on average. The ranks of large-tonnage products now include, for example, terephthalic acid and others for which individual production capacities amounted to a few tens of thousands of tons per year, at best, in the 1980s and early 1990s (now they are up to hundreds of thousands).

Russia today has no real capabilities for producing modern chemical and petrochemical equipment. In practice, there are too many obstacles to doing this, starting with certification, if nothing else. The equipment has to be accepted by foreign licensers (who have the rights to chemical technologies) as suitable for use in the respective technological processes.

Another problem involves the extremely limited possibilities for cooperation and putting together production chains set up and established within the framework of the sector's individual firms. In practice, these interrelations are possible only on the basis of adequate sectoral infrastructure—a system of specialized transportation facilities that make it possible to organize efficient flows of feedstocks and intermediate products with minimal costs.

Unfortunately, such infrastructure is almost nonexistent in Russia, as are reasonable ideas about possible ways of developing them. For instance, the whole specialized transportation infrastructure of the Russian chemical complex is two ethylene pipelines (one from Nizhnekamsk to Sterlitamak and the other from Angarsk to Saiansk), with a total length of approximately 1,000 kilometers, and one ammonia pipeline for exports, which connects Tol′iatti with the Black Sea ports of Ukraine. All other flows of heavy-cargo products (intermediate and final) are by rail, which is too expensive, slow, and unreliable.

The lack of transportation infrastructure is not just our problem, however: even European countries envy the United States, where more than 95 percent of the capacities for producing olefins (basic intermediate products for most petrochemical syntheses) are interconnected by a system of product pipelines. In Europe, olefin pipelines encompass only 50 percent of existing capacities. A project is now under way to create a trans-European network of olefin pipelines. The project is designed for the period up to 2020 and includes plans to improve the distribution of production capacities (a few large, new, world-scale complexes will be created instead of relatively small, obsolete production facilities).[7] A specialized chemical infrastructure is also being developed in China and countries of the Middle East; apparently, all we can do about implementing such projects is dream.

From all of this we can conclude that the practical realization of any large-scale chemical projects in Russia will involve not only the use of foreign technologies but also, most important, turnkey deliveries of imported equipment. This has a negative impact on the cost of such projects, not only because imported equipment is more expensive than Russian equipment but also because of the very expensive tie-in of imported production processes to new territories.

In contrast, for example, to Saudi Arabia or China, Russia is not yet a major import player in the chemical technologies market, and so the requirements set for Russian purchasers by licensers and equipment suppliers will be stricter. Plus (with a big minus sign, it is true) the existing infrastructure problems.

At present, it is much easier and cheaper to build a large chemical plant somewhere in the Middle East or Asia than in Russia, especially in the oil and gas regions of Western and Eastern Siberia, where the main hydrocarbon feedstock resources are concentrated, without the necessary infrastructure and

Table 7

Comparison of Government Participation in the Development of the Gas- and Petrochemical Industry in China, Saudi Arabia, and Russia

Sphere of regulation	China, Saudi Arabia	Russia
Integration of the gas- and petrochemical sectors supply chains	Direct or indirect regulation of prices for feedstock: state monopoly (Saudi Arabia) or state company (China)	Market relations between companies
Choice of projects	Government regulation	Absence of coordination
Financing the development of processing, taking into account the capital intensity and long-term nature of investments	Government support through state funds and state banks, on favorable terms in the initial phase	Private, relatively expensive borrowed funds
Development of national transportation infrastructure for feedstock and product flows	Government programs and financing, construction of product pipelines	No development of infrastructure for the gas- and petrochemical industry

Source: D.V. Konov, "Neftekhimiia v usloviiakh krizisa," OAO SIBUR Holding Company, 2008; available at www.sibur.ru/files/Konov_press-conf_Dec2008.pdf.

at distances of 3,000–3,500 kilometers to the west or to the east, to consumers in the central part of Russia or to export seaports.

Transportation costs add approximately $100–150 per ton to the production costs, which is no help for increasing the efficiency of investment projects and improving the competitiveness of Russian chemicals in the sales market. The only plus is that the considerable transportation costs serve as fairly good protection for domestic companies against foreign competitors.

However, in the matter of creating favorable conditions for the development of the chemical industry we cannot rely on chance or on the belief that foreign competitors will be afraid of the vast Russian spaces. A purposeful government policy is needed, one that takes into account not only the sector's significance for the national economy but also the problems and difficulties that are hindering its normal development. Very regrettably, the Russian government has not yet shown any desire to conduct such a policy or the capability of doing so, in contrast to the authorities in China or Saudi Arabia (Table 7). All we could do was to work out and adopt a medium-term strategy for the development of the chemical complex that contains useful benchmarks, without any mechanisms for achieving them.[8] In essence, this is nothing more than a declaration of intentions.

Summarizing what has been said above, we consider it our duty to point out that *the main barrier to the development of the Russian chemical industry in the current conditions is the government's virtual inaction*. Modernization of the economy is impossible without intensive, accelerated development of the chemical industry. If the country needs modern automotive, electrical engineering, electronics, furniture, textile, and numerous other industrial sectors, as well as a military-industrial complex, an aircraft industry, and a stably developing space complex, if we do not want to depend on foreign countries to supply us with pharmaceuticals, all of these sectors need Russian-made chemicals. In the final analysis, the development of the nanotechnologies so beloved by our government also relies on the achievements of scientific and industrial chemistry.

Not just acceleration, but a sprint

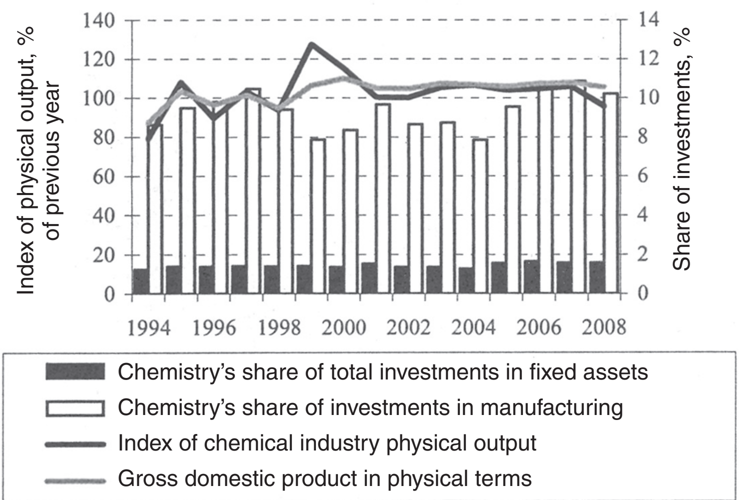
The evolutionary development of the Russian chemical industry that is occurring on the basis of existing capacities and firms will not alter the situation as it now stands. *What is needed is a qualitative sprint: the construction of large firms in various regions of the country, based on modern technologies oriented to the production of high-quality products that meet the demand of the domestic and international markets*. However, because of the lack of our own technologies, the insufficient capabilities of domestic chemical machine building, infrastructure constraints, and the government's inaction, it will be very hard to carry out these plans.

Still, with the proper stimulation of domestic consumption, we can count on considerable growth in the demand for chemical complex products from industry, agriculture, transportation, and other sectors.

But, in assessing the prospects for domestic demand for chemical products, it cannot be directly tied to the economic growth rate (gross domestic product), population size, or household income. There is such a thing as "quality growth."

In the past five to seven years before the crisis, Russia's economic growth rate was higher than that of almost all major countries, except China and India. However, this high growth rate was largely due to development trends in the mineral raw materials sector (primarily oil and gas), as a result of the exceptionally favorable situation in the international raw materials market. At the same time, there was not even a hint of accelerated development of manufacturing sectors, including the chemical one. This is clearly confirmed

Figure 10. **Indexes of Chemical Industry Physical Output and Its Share of Investments in 1994–2008**



Source: Federal State Statistics Service, Central Statistical Database (TsBSD); available at www.gks.ru/dbscripts/Cbsd/DBInet.cgi.

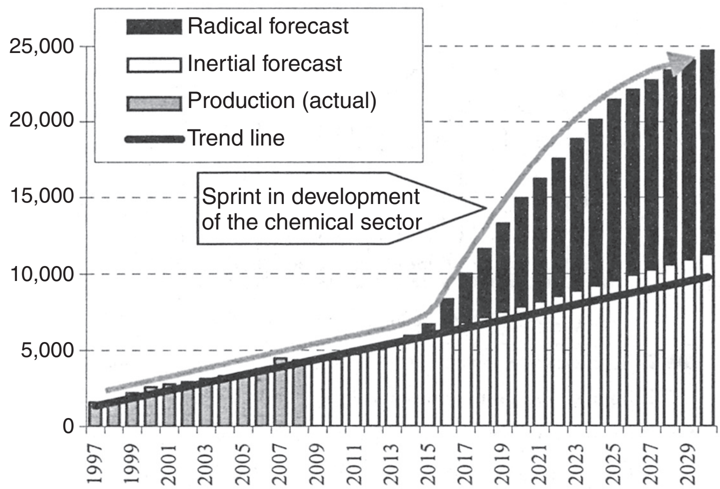
by the dynamics not only of production indexes but also of the sector's relative share of investments in the economy, which has not been more than 1.4–1.6 percent for the past fifteen years (Figure 10).

Neither the oil-producing countries of the Middle East, which have created a highly competitive, export-oriented petrochemical industry on the wave of the oil boom, nor China, where the annual growth rates of the petrochemical industry, which is primarily oriented to the domestic market, have been 15–20 percent recently, have become an example for Russia. Our country lags catastrophically behind old and new industrial countries not only in development of the chemical sector itself (including the petrochemical one) but also in consumption of chemical products and the level of chemization of the economy [increasing the use of chemicals and chemical methods of processing in the economy]. This indicates a low quality of economic growth and the lack of important, fundamental prerequisites for improving the economic and energy efficiency of the national economy.

Undeniably, Russia simply needs a sprint in the development of chemistry and petrochemistry. If it is not to lag behind other countries forever, the country simply has no other choice.

The path of inertia that the country has taken in recent years and is forecast

Figure 11. **Comparison of the Inertial (traditional) and Radical Ideas About the Prospects for the Development of the Chemical Industry in Russia, on the Example of Synthetic Resins and Plastics Production in 1997–2030** (1,000 tons)



(in particular, by foreign consulting and analytical firms) for the coming years is unacceptable. For example, in the synthetic resins and plastics subsector, to approach the level of consumption of polymer materials in industrially developed countries would require not doubling output, but increasing it 400 percent by 2030 (Figure 11). And only after this would it be possible to construct forecasts for the development of the chemical industry by the traditional procedure, based on the overall economic growth rate.

The eastern jumping-off place for the gas chemical complex

Big hopes are now pinned on eastern regions of the country, where the intensive creation of a new oil and gas production complex is beginning. Increased attention is being given to the gas component there. In the so-called Eastern Gas Program (developed by Gazprom and approved by Order no. 340of the RF Ministry of Industry and Energy of September 3, 2007), which sets the direction for development of the gas industry in Eastern Siberia and the Far East, one of the main objectives is "development of the gas-processing and gas-chemical industry in the region for producing high value-added products."[9] In particular,

Table 8

Basic Indicators of the Eastern Gas Program in 2005–2030

Indicator	2005 (actual)	2010	2015	2020	2030
Production, consumption, and export of gas, billion cubic meters					
Gas production, total	3.5	27.4	45.7	107.1	120.0
Eastern Siberia	—	4.9	20.7	48.3	49.7
Far East	3.5	22.5	25.0	58.8	70.3
Final gas consumption	3.5	9.6	16.5	37.9	43.3
Eastern Siberia	—	0.8	4.5	15.7	17.4
Including consumption for gas chemistry	—	—	—	6.6	6.6
Far East	3.5	8.8	12.0	22.2	25.9
Including consumption for gas chemistry	—	—	—	7.0	7.0
Gas exports to countries of the Asian Pacific Region	—	13.7	22.3	53.1	58.7
Production of processing sector products					
Petrochemical feedstock, 1,000 tons	—	500	2,560	7,060	6,860
Helium concentrate, million cubic meters	—	5	47	224	228
Chemical products, 1,000 tons	—	—	630	12,910	13,750

the program calls for increasing the output of chemical products (ammonia, methanol, polyolefins, etc.) to 13.8 million tons by 2030 (Table 8).

We can boldly state that the development of gas resources in the eastern part of the Russian Federation will provide very good prerequisites for making a "chemical sprint."

First, the gas sector in the eastern part of Russia (in contrast to Western Siberia or the Ural-Volga region) is in the formative stage, which allows some leeway in time for preparing and carrying out large-scale gas- and petrochemical projects. They will be based on growing, not falling, gas production.

Second, the development of the chemical industry in Eastern Siberia can efficiently use the region's energy potential. While it is at a disadvantage in relation to central and border regions of the country in product transportation costs, Eastern Siberia has obvious advantages in its provision with hydroelectric power. Here, in contrast to other regions, it is not necessary to burn gas to supply chemical firms with electric power.

Third, eastern regions have considerable potential for increasing their own consumption of chemical products, through the development of the wood-processing industry, machine building, industrial and civil construction, and agriculture.

Fourth, the Russian East has a relatively good competitive position for exports of a number of polymer products to countries of the Asian Pacific Region.

But without the government's active and direct participation, these favorable prerequisites are not being realized. Not only are effective government measures needed to stimulate the development of processing facilities themselves (through tax benefits, limiting the rates charged for transportation and electricity, etc.), but also, even more important, a whole set of measures aimed at stimulating domestic demand for chemical products.

Since the regions of Eastern Siberia are far from potential sales markets for most types of chemical products, and the domestic regional need is quite limited, product sales (to both Russian and foreign consumers) will involve substantial transportation costs. This will make the products less competitive and the projects less economically efficient. And the current capacity of the whole Russian market for chemical products is too small in comparison with the possibilities for the development of production based on Eastern Siberia's gas resources. The most critical sales problems characterize large-tonnage basic types of chemical products—ammonia and methanol as well as their closest derivatives (carbamide, nitrogen fertilizers, and formaldehyde solutions).

Moreover, the possibility of an export orientation in the production of basic chemical products seems quite problematic today. This is not only because of the remoteness of Eastern Siberia from international shipping facilities (generally seaports) but also because of the presence of very strong competitors, primarily Chinese and Middle Eastern producers that have significant advantages with respect to many parameters.

The high concentration of capacities for gas production, transportation, and processing potentially makes it possible to lower the unit costs in all stages of the production process, but in absolute terms these costs will be very high (especially considering the additional expenses for extracting and storing helium). The financial aspect associated with attracting investments can play perhaps the key role in implementing eastern projects to develop gas processing and gas chemistry.

The directions for development of all the key aspects of gas processing and gas chemistry in the eastern part of Russia need to be carefully substantiated, as do the locations of future firms, the choice of product specialization, and the construction sequence and schedules, which must be coordinated with the commissioning of production capacities and infrastructure facilities. In essence, we have to talk about creating a development strategy based on adequate consideration of a whole host of internal and external factors. A strategic approach will make it possible to overcome a certain sketchiness of the Eastern Gas Program in regard to implementation mechanisms and excessive determinacy of its benchmarks, many of which are no longer timely—at least quantitatively.

Chemistry as a tool for monetizing gas resources

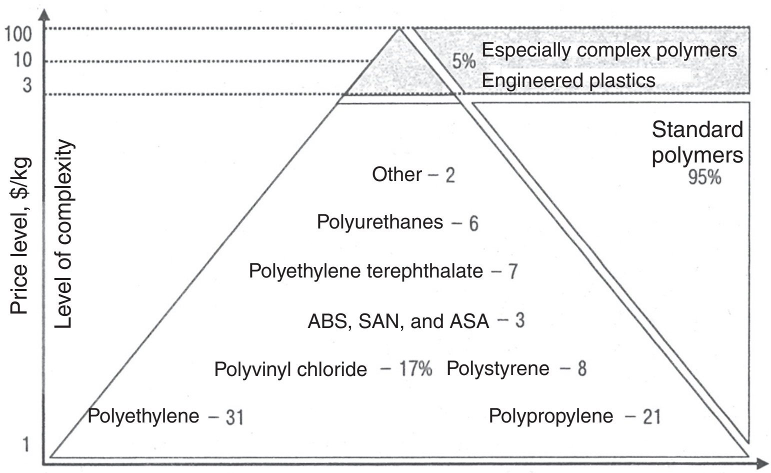
One of the main reasons for the development of advanced chemical processing in the utilization of gas reserves is monetization—an attempt to use products with high value added not only to recoup all the costs of gas utilization but also to make an additional profit. The idea of monetization of hydrocarbon feedstock resources is enticing primarily to production companies, but such a view is not alien to the government either. And success will depend on the value (price) of the products. However, there are a number of constraints on the possibilities of producing the most expensive chemical products.

The general constraint is that when the price of chemical products rises, demand generally decreases, due to the limited nature of the sphere of use, or the impossibility of widespread use at the existing prices, which are dictated by high production costs.

The basic large-tonnage products (ammonia, methanol, lower olefins, and their primary derivatives) form the base of the chemical pyramid. They are used to meet final needs and also as feedstock for producing more complex derivative products. An example of the pyramid of polymerization plastics (Figure 12) shows that more than half of world plastics production (approximately 200 million tons per year) consists of two basic products: polyethylene and polypropylene. The share of relatively cheap polymer materials (up to $3,000/ton) totals approximately 95 percent, and 5 percent is plastics for engineering and technical purposes as well as heat-resistant and high-strength plastics.

This creates a dilemma: the problem of utilizing large gas resources can be solved only by establishing large-capacity processing facilities, which implies priority orientation to the production of basic chemical products. But the value of these products is relatively low and declined considerably as a result of the drop in oil and gas prices in 2008–9. Moreover, the profits from sales of basic types of chemical products are lowered by high transportation costs. Therefore, it seems preferable to produce complex and expensive chemicals, the prices

Figure 12. **Pyramid of Polymerization Plastics** (%)



Source: Celanese Corp. Presentation, Credit Suisse 2008 Chemical and Ag Science Conference, September 2008. http://www.celanese.com.
ABS—Acrylonitrile Butadiene Styrene, SAN—Styrene Acrylonitrile, ASA—Acrylonitrile Styrene Acrylate.

for which correlate with the dynamics of economic growth, rather than with oil and gas prices. But the production of chemical products is characterized by heightened capital intensity, with a limited scale of the market, which is not conducive to utilization of large feedstock resources.

Therefore, the problem consists in selecting efficient ratios—from the point of view of the investing company and the government—between the production of so-called gas-chemical products (methanol, ammonia, carbamide, etc.) and petrochemical (polymer) products, and between large-tonnage and complex forms of them. In this case, it should be taken into account that the division of products into gas- and petrochemical ones is fairly arbitrary, especially considering the broad possibilities for combining production processes and the overlapping of product lines. Nevertheless, products made directly from methane (dry) gas are usually classified as gas-chemical, and those the feedstock for which is primarily hydrocarbons, starting with ethane, and heavier ones are classified as petrochemical (Table 9)

It is expedient to use the ethane and heavier hydrocarbons contained in sour gas completely for the needs of chemical processing, since the prices for the basic polymers produced in this case are three to four times higher than for the basic types of gas-chemical products. Decisions regarding the use of the

Table 9

Example of How Gas-Chemical and Petrochemical Products Are Structured

Segment	Gas-chemical			Petrochemical		
Upstream	Ammonia	Methanol		Ethylene	Propylene	Aromatics
Downstream	Carbamide	Formaldehyde solution	Acetic acid	Polyethylene	Polypropylene	Organic synthesis products
	Urea resins			Synthesis products		
	Nitrogen fertilizers			Organic synthesis products		
	Polyacetals			Polymer products		

gas's methane component for chemical processing should be made based on a comparison of the likely advantages from chemical product sales obtained in this case (methanol, ammonia, carbamide) and fuel gas. In addition, the possibilities for using new processing technologies to produce traditional petrochemical products—ethylene and propylene, which are feedstock for producing basic polymers—from methane (e.g., through methanol) should also be taken into account.[10] As for complex petrochemical products, they need to be included in the product assortment gradually (as future plants are developed), and in the initial stage it is better to limit the assortment to one or two types, in order to make the projects more profitable.

It should be noted, in particular, that in seeking the most efficient structure of gas-chemical production facilities contradictions may arise between various interests. This has been confirmed by calculations according to a model of optimization of the structure of a gas-chemical complex with a capacity for 12 billion cubic meters per year of sour gas that reflects the conditions of location in Eastern Siberia, using three different optimality criteria. These are:

1. maximum overall integral effect—differences between the discounted benefits and costs over a twenty-year period, disregarding the distribution of income between the investor and the state;
2. maximum commercial efficiency (the investor's return)—the so-called net current value; and
3. maximum direct income to the state in the form of the discounted amount of taxes received (i.e., budget or fiscal efficiency).

If all of the costs and risk are shouldered by the investor, each of the optimality criteria listed above is satisfied by its own version of the optimal structure of gas-chemical complex production facilities (product output), which is different from the others. In this case, the most important thing is the discrepancy between the government's fiscal interests, which reflect the idea of monetization of gas resources in the context of direct budget revenues, and the broader interests of the national economy as a whole.

It is not enough to remove the hurdles, good doping is also needed

For the chemical sprint to take place, first the hurdles and obstacles that hinder the sector's development in Russia have to be removed. But that still does not guarantee the large-scale development of chemical production, especially in eastern regions of the country. Multiple, integrated measures are needed for government support of existing producers of chemical products and potential ones (oil- and gas-producing companies) (Table 10).

Table 10

Basic Measures for Government Support of the Development of Chemical Production

Types of support	Measures for government support
Lowering costs for the construction of new plants	Participation in investments in production and social infrastructure facilities (e.g., through the RF Investment Fund). Lowering or abolishing customs duties on types of imported production equipment not produced in Russia
Providing possibilities for efficient product transportation	Coordination of companies' operations (projects) in the field of oil and gas transport, taking into account the development of primary and advanced chemical processing. Participation in investments in a system for transporting feedstock and products, and export terminals, on public–private partnership principles
Stimulating the production of feedstock for the chemical industry	Stimulation of integrated programs for utilizing associated petroleum gas, emphasizing the development of gas processing and gas chemistry. Assistance for maximally complete extraction of valuable components (C_2 and higher) from natural and petroleum gas for their processing, primarily before the gas goes to export
Creating new production capacities	Provision of benefits (on profit and property taxes) for new production facilities until the costs of the projects have been recouped, but for no longer than the term of financing. Coordination by the government of the strategies of various participants/companies in the field of developing chemical production. Coordination of plans for the development of the chemical industry with regional development programs and programs for the development of other sectors
Consolidating the sector for implementing government policy	Elimination of grounds for corporate conflicts and unfair competition. Assistance for optimizing feedstock and product flows on a national scale. Promoting the Russian chemical industry's access to foreign markets and strengthening its position in them. Transfer of regulatory functions in the sector to a unified government agency

The mechanisms of government support should vertically encompass the whole chain of types and spheres of operations, starting with the use of subsurface resources and ending with the consumption sphere of chemical products, and they should affect all of the fundamental aspects of operations that determine the ultimate efficiency of the system as a whole. What is needed is a broad set of measures not only in the sphere of production, transportation, and processing of the feedstock, but also in stimulating domestic demand for chemical products.

A systematic economic and industrial policy that sets strategic goals and priorities for projects to increase the use of chemicals and chemical processing methods in the Russian economy should start from the fact that the colossal lag behind developed countries in the development of the chemical and petrochemical industry, and also in the volume and nature of consumption of chemical products in Russia, is incompatible with the objectives of the national economy's transition to an innovation development path. Anticrisis measures are necessary, of course, for supporting the producers of chemical products in the current conditions, but such measures are not capable of fundamentally solving the burden of problems that have accumulated over the past two decades.

It is important for a systematic chemization policy to have an impact on almost all types of economic activity, all economic sectors, and the social sphere, since they are all related (or should be) to the consumption of chemical products. Within the framework of measures pertaining to each specific sector and type of activity, the distinctive characteristics of consumption should be taken into account (volume, growth trend, product mix, prices, preferences, degree of impact on economic indicators, etc.), and measures for stimulating demand and ways of having an impact should be selected for specific types of chemical production (e.g., as shown in Table 11). The ranking of stimulating measures should be directly related to the potential scale of use of chemical products and the economic effect that can be obtained as a result of expanding demand.

In cases when consuming sectors demonstrate not only large-scale but also diversified demand for chemical products, the format of federal target programs may be appropriate. This is primarily true of construction (including the maintenance and overhaul of buildings and structures) and the production of consumer goods (including light industry and household appliances and electronics). For example, in our opinion, it is extremely important to have an integrated program (with the status of a federal target program) to modernize and reconstruct the housing stock and facilities of the housing and utility complex. Along with stimulating new construction, this program will provide a powerful impetus for increasing demand for

Table 11

Elements of Government Policy for the Development of the Domestic Market for Chemical Products

Basic consuming sectors	Government measures to support demand
	Polyethylene, PVC, thermoelastic plastics
Construction: Pipes, building components, roads	Programs to expand and stimulate the construction complex. Adoption of standards and rules for using advanced materials and products made of them
	Polyethylene, polypropylene, polycarbonates, polyolefins, rubbers
Automotive industry: Automotive components, tires	Stimulation of demand for Russian-made automobiles. Establishment of clear requirements for localization of production of automotive components for foreign companies that have assembly plants in Russia
	Polyethylene, polypropylene, PET, PVC, polystyrene
Consumer goods: Packing, products made of plastic	Import substitution. Support for firms that process plastics
	Carbamide, saltpeter
Agriculture: Fertilizers	Subsidies and lending for agricultural producers. Stimulation of long-term investments in farmland

polymer products used in the production of window frames, pipes and plumbing products, insulation, roofing materials, paints and varnishes, and other types of products.

It is important for the program's goals and objectives to be backed up by the development and adoption of technical regulations, standards, and rules for using advanced materials and products made from them. Clear requirements should be formulated for the localization of production of the raw materials (polymers) and components used in the automotive, aircraft, electrical engineering, and electronics industries, especially for assembly plants belonging to foreign companies.

As an example of the government's influence on increasing the domestic market's capacity for the chemical complex's products, we cite the development of the domestic automotive industry in the industrial assembly system. Since the cost of plastic, paints and varnishes, and resins amounts to about 30 percent of the cost of an automobile, on average, strict conditions for the localization of production of automotive components within Russia can significantly increase the demand for many types of high-quality chemical products that replace imported equivalents. Stimulatory measures can also be used in construction (in particular, in window frame production), which is one of the main consumers of polyvinyl chloride, as well as in other economic sectors.

The efficiency of government measures to stimulate demand for chemical products is indicated by the example of China, which was able to avoid a decline in demand for polymers even in the crisis of 2009. Thus, in the first quarter of 2009 a favorable environment for the Chinese petrochemical industry was created by adopting government programs intended to stimulate the consumption of plastics in rural areas. Starting February 1, 2009, farmers purchasing televisions, refrigerators, mobile telephones, washing machines, and air conditioners received a 13 percent discount. Thanks to this, in March alone the sales of household appliances rose 70 percent in comparison with the previous month, and the consumption of plastics returned to the precrisis level of the first quarter of 2008. While the output of plastic products fell 4.6 percent in January 2009 in comparison with the previous month, by February, 16.2 percent growth was already noted. On the whole, production in the first months of 2009 increased 5.1 percent.[11] If the government conducts an effective policy to stimulate the development of basic economic sectors, it can significantly affect the development of the domestic market for chemical products. But in doing so, it is extremely important to synchronize and coordinate measures intended to encourage demand and to develop the chemical industry. Otherwise, we will get nothing but a bigger market shortage and a price increase for products that have to be largely imported anyway because our own production capacities are limited.

Notes

1. P. Skelley, "The Trans European Olefins Pipeline Network Project—Benefits to the European Industry (Brussels: Association of Petrochemical Producers in Europe, 2008); available at www.petrochemistry.net/.

2. "Strategiia razvitiia khimicheskoi i neftekhimicheskoi promyshlennosti na period do 2015 goda" (Approved by Order no. 119 of the RF Ministry of Industry and Energy of March 14, 2008); available at www.minprom.gov.ru/activity/chem./strateg/0.

3. *Programma sozdaniia v Vostochnoi Sibiri i na Dal′nem Vostoke edinoi sistemy dobychi, transportirovki gaza i gazosnabzheniia s uchetom vozmozhnogo eksporta gaza na rynki Kitaia i drugikh stran Aziatsko-Tikhookeanskogo regiona* (Moscow, 2007).

4. Industrial introduction of new production processes developed by the UOP/Hydro and Lummus companies—Methanol-To-Olefins (MTO) and Olefins Conversion Technology (OCT)—has already begun. Together (MTO/OCT), these processes make it possible to almost completely convert gas feedstock (methane) to olefins, flexibly varying the ratio of ethylene and propylene outputs.

5. According to information from the Internet project Polimernaia industriia (http://plastinfo.ru).

6. O. Kubinova, "Kuda idet rodnoi khimprom," *Chemical Journal*, 2009, no. 11, pp. 32–37.

7. O.B. Braginskii and I.E. Krichevskii, "Khimicheskaia i neftekhimicheskaia promyshlennost′," in *Nauka i vysokie tekhnologii Rossii. Na rubezhe tret′ego tysiacheletiia,* ed. V.L. Makarov and A.E. Varshavskii, ch. 8, pp. 226–54 (Moscow: Nauka, 2001).

8. B.I. Losev, M.L. Monina, and G.V. Putintsev, *Ispol′zovanie plasticheskikh mass i sinteticheskikh materialov v neftegazovoi promyshlennosti* (Moscow: Nedra, 1964), p. 7.

9. D. Aleinov, "Vtoraia volna," *Khimiia i biznes*, 2009, nos. 3–4; available at www.chembus.ru/?q-node/61/.

10. United Nations, *2008 International Trade Statistics Yearbook* (New York: UN Statistics Division. International Merchandise Trade Statistics Section, 2010); available at http://comtrade.un.org.

11. The number of ratings corresponds to the total number of commodity trade items (classes) according to the classification used in the UN's statistical accounting system (SITC Rev. 4); available at http://unstats.un.org/unsd/cr/registry/regcst.asp?C1-28.