

# Scenarios of Russian Energy Future

by Alexei A. Makarov\*

Since 2007, the new Energy Strategy up to the year 2030 is being developed as per the Innovation Scenario produced by the Ministry of Economic Development, Russian Federation (MED). Moderate increase of world oil prices is envisioned in this scenario after the slight decline in 2007-2008. In 2015, the oil price is expected to reach 60-70 \$/bbl and 75-85 \$/bbl by the year 2030. New innovative technology is expected to become the main source of growth in certain sectors of the traditional economy such as energy, transportation, and agriculture as well as in some high-tech branches. The MED calculates that the annual Russian GDP growth rate in 2011-2015 will average at 6.2 percent a year with acceleration to 6.6 percent in 2016-2030. GDP will more than quadruple from 2005 to 2030.

The Energy Strategy shall not ignore some major uncertainties related to world energy developments – a long-term probability of high energy prices and coordinated measures of major industrialized countries to reduce emissions of greenhouse gases to prevent climate change. Based on the MED's Innovation Scenario, ERIRAS has developed two additional scenarios, which were calculated using ERIRAS' Sectoral Macroeconomic Model. This model has a similar purpose and structure as a regional block of the US EPA's SGM and IGEM models<sup>1</sup> with the added feature of financial assumptions about development of particular sectors and the economy as a whole.

The Favorable Scenario corresponds with higher world prices for energy and other raw materials.<sup>2</sup> Higher export revenues would allow for transformation of Russia into a world leader in the production and export of high-tech processed materials for wide usage [*this concept is described in more detail in source 8*]. Low cost hydro power from mainly Siberian sources will facilitate production of high quality materials with higher added value.

The Ecology Scenario creates lower environmental impact and corresponds with moderate oil prices. In this scenario the economy will grow more slowly because of additional cost of environmental protection. Model calculations describe the Favorable Scenario's GDP growth rates as being 0.3-0.4 percentage points higher than those in the Innovation Scenario. The same calculation in the Ecology Scenario provide 0.3-0.4 percentage point lower figures. As a result, the GDP growth rate sensitivity to oil price change plays a less significant role than infrastructural and technology issues.

The main problems facing the Russian energy sector are the result of the extraordinary high energy intensity of the national economy. In 1990, the Russian GDP energy intensity was almost 6 times higher than the world average. By 1996-1998 this gap increased to 7 times. As the economy started to grow toward the end of the 1990s, GDP energy intensity started to decline. The high rate of decline could be compared only to previous Chinese performance. In 10 years Russia has reduced the difference by one third but now the gap is still about 3.5 times the world average and 9 times the US and EU performance data. So, the reduction of GDP energy intensity continues to be the main priority of the Russian Energy Strategy.

However, according to the Innovative and Favorable Scenarios, the reduction of GDP energy intensity will slow down as compared to record breaking rates of the past decade because of the following two reasons: First, from one quarter to one third of the actual reduction has resulted from the growth of energy export prices. With the moderate increase of energy costs of actual material exports GDP input has more than doubled thanks to galloping world prices. Second,

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the restoration of the economy after the post-Soviet crisis was completed and transition to a more capital intensive phase would necessarily be more energy intensive. As a result, we expect that energy consumption will increase by 65 to 76 percent from 2005 to 2030 (see Table 1).

**Table 1: Scenario Assumptions**

	Favourable			Ecology		
	2005	2015	2030	2005	2015	2030
Population (million people)	143	140	142	143	140	142
GDP Growth Rate (percent/year)	6.4	6.9	4.9	6.4	6.5	4.5
Personal Consumption (2005 = 100)	100	186	435	100	184	410
Per Capita Energy Consumption (tce)	6.65	8.2	11	6.65	7.9	9

The Ecology Scenario is not feasible if the rates of GDP energy intensity reduction can not be sustained at the levels achieved in 1998-2007. It will require introducing a number of regulations and economic incentives including equalizing domestic natural gas prices<sup>3</sup> with export prices and introducing greenhouse gases emission payments.<sup>4</sup> Under active implementation of the above measures, the energy consumption in the Ecology Scenario will increase only by 35 percent or only by half of that in the more conservative scenarios.

Russia owns one fifth of the world reserves of organic fuel, but over the last two decades the annual reserves additions were significantly lagging behind production.

**Table 2: Russian Energy Scenarios**

	2005	2010	2015			2020			2030		
			1	2	3	1	2	3	1	2	3
<b>Demand (mln tce)</b>	949	1062-1055	1180	1195	1115	1315	1355	1175	1585	1680	1270
Natural Gas	495	561-555	607	618	590	650	670	610	695	730	610
Petroleum	181	207-209	245	245	235	270	275	245	325	345	270
Solids	167	180-178	205	210	165	235	250	155	300	320	135
Non-Fuel	106	115-113	125	122	125	160	160	165	270	285	255
<b>Energy Exports (mln tce)</b>	865	926-935	1000	1060	1015	1035	1125	1055	1025	1090	1075
CIS	117	170	170	170	170	170	170	170	130	130	135
Europe	613	641-647	675	710	680	650	730	655	650	695	690
Asia	75	115-118	155	180	165	215	225	230	245	265	250
<b>Supply (mln tce)</b>	1733	1890-1898	2080	2155	2030	2250	2360	2135	2525	2645	2270
Natural Gas (bln m <sup>3</sup> )	641	700-707	800	830	790	880	895	850	940	970	870
Petroleum (mln t)	470	507-510	530	560	530	535	595	535	560	600	560
Coal (mln t)	299	343-335	385	387	330	440	450	320	525	545	300
Hydro (bln kWh)	175	183	200	200	202	245	255	247	330	390	325
Nuclear (bln kWh)	149	172-168	225	225	225	330	330	330	600	600	580
Renewable (mln tce)	2	4-5	9	9	15	15	15	28	35	35	70
<b>Energy Imports (mln tce)</b>	80	99	100	105	115	100	120	125	90	130	130
1 = Innovation Scenario 2 = Favourable Scenario 3 = Ecology Scenario											

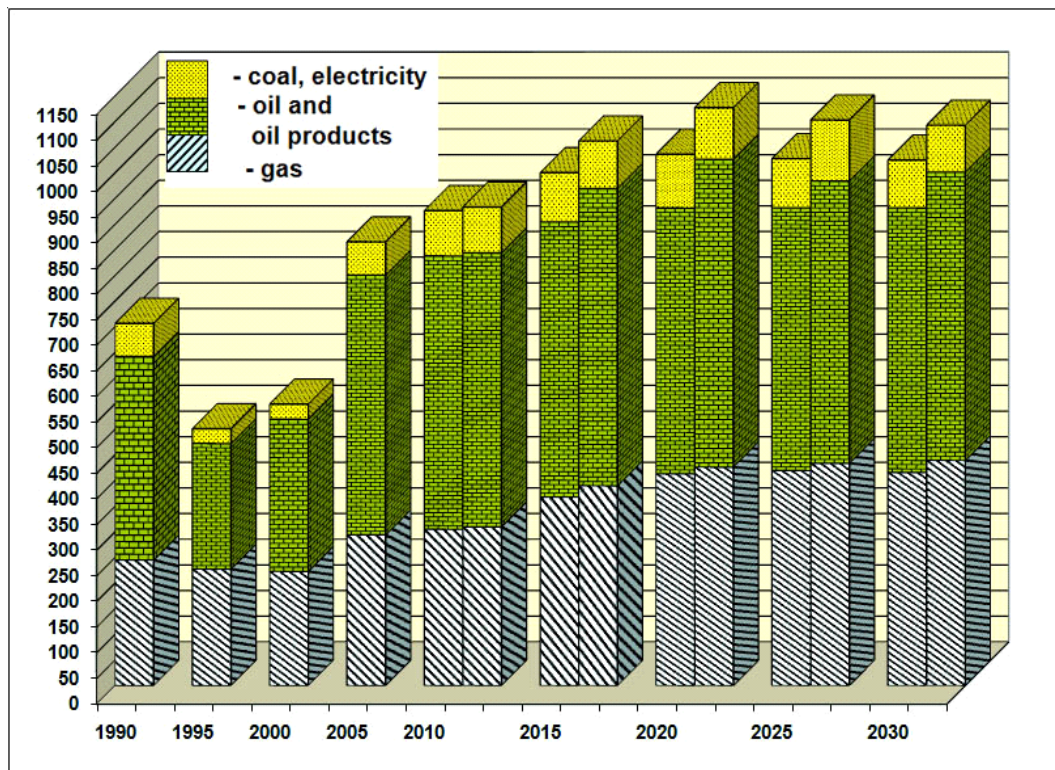
If the exploration and upgrade from probable to proven reserves would be accelerated (the Energy Strategy assumes some complex measures to make it happen), commercial primary energy production in the Innovation and Favorable Scenarios should increase by 45 to 55 percent from 2005 to 2030 (see Table 2). Energy supply structure will change in a favorable direction – share of coal, nuclear and renewable energy will increase by half thus replacing petroleum, which will drop from a 39 to 32 percent share. However, the share of natural gas will stay at its current level of 42-43 percent. This means that Russia would not be able to further diversify energy supply structure, and natural gas would continue to play a dominant role.

One of the main goals of the Energy Strategy is to define an efficient natural gas production strategy in terms of depletion of old reserves and new gas fields development. We expect Russian annual gas production to peak in 2030-2050 at 950 bln m3 with a following acceleration of conventional gas production decline partly compensated with development of huge hydrates deposits.

Another important goal is to assure an efficient development of the national electric power sector. With expected growth of the economy and energy consumption as forecasted in the Energy Strategy, power station capacity in the Innovation and Favorable Scenarios should increase by 2.1 to 2.3 times from 2005 to 2030, with tripled growth of transmission lines. Power generation would increase by 2.4 times but the introduction of new technologies would slow down its demand on primary resources. Total use of primary resources in power generation would grow only by 1.9 to 2 times and organic fuel consumption by 1.7 to 1.85 times. Natural gas usage will increase only by 42 to 50 percent thus decreasing its share in the power sector fuel mix from 68.6 percent in 2005 to approximately 57 percent in 2030.

Commercially sustainable energy exports under accepted price assumptions shall increase 20 to 30 percent by the year 2020 and then will start a slow decline mainly due to decline of oil exports (see Figure 1). Dependency of the Russian economy of energy exports will also gradually decline. Diversification of export routes with a growing share of exports to the Asia-Pacific region from 8.7 percent in 2005 to 23-24 percent in 2030 shall reduce an absolute dominance of the European market in the Russian export shipments.

**Figure 1: Russian Energy Exports**  
(mln tce)



The above scenarios shall significantly increase the environmental impact of the Russian energy sector. By 2020, greenhouse gases emission shall exceed 1990 levels taken as a base in the Kyoto process and, in 2030 levels will exceed that threshold by anywhere between 11 and 17 percent. This presents a threat to sustainable development in Russia.

In the Ecology Scenario the results are much more favorable. First, power generation will be significantly different. Nuclear and hydro power will be prioritized as in other scenarios. Instead of coal stations modern steam-gas technology will be used. This will significantly reduce total primary energy consumption as compared to traditional scenarios. Renewable energy also will be fast growing, especially biomass usage. Share of natural gas in power station fuel mix will be up to 74 percent higher but its actual consumption will be lower than in traditional scenarios.

Declining gas consumption in the power sector shall allow natural gas production to stabilize without reduction in gas exports. After 2015, coal production also could start declining. As the result, greenhouse gas emission by energy sector shall stabilize in 2015 – 2020 at 80 to 82 percent of 1990 levels and then shall further decline to 78 to 80 percent by 2030. This will require an increase of investments into energy conservation, which will lead to technological modernization of both energy production and energy consumption. Energy investments will grow more slowly because of lower demand on gas and coal and lower capital needs of gas feeds as compared to coal supplies.

The Russian energy sector creates a heavy load onto a national economy well exceeding comparable figures for other countries with the notable likely exception of Saudi Arabia. The International Energy Agency reports that a 1.5 percent of GDP world investment in the energy sector has taken place over the last 20 years. The agency forecasts 1.3 to 1.5 percent GDP investments up to the year 2030. This will create a huge 20 trillion+ dollar capital pool but the overall level of economic load would not change over current levels and may even decline.

In sharp contrast, according to traditional scenarios, Russia shall invest between 6 and 8 percent GDP annually against the 4 percent which was spent in the last five years. Such a load will bring the economy to its limits. It is still not clear if Russian would be able to bring this to acceptable levels in the Ecology Scenario. Based on our previous studies, we can conclude that at the price of a slower GDP increase and personal consumption growth the Russian economy may get additional incentives for innovative development because of wide technological renewal of overall energy sector and slower growth of traditional heavy industries – oil, gas and, especially, the coal industry.

The world economic crisis has caused significant changes in Russian economic and energy prospects. Existing forecasts are being corrected towards lower figures, which shall promise some lowering of the environment impact of energy development. Rational combination of economic growth with energy sector development and environment protection plus creation of organizational approaches to its realization, constitute the main content of the Russian Energy Strategy.

### **Endotes**

<sup>1</sup><http://www.economics.harvard.edu/faculty/jorgenson/files>

<sup>2</sup>Price of Urals Russian export blend will increase in this scenario to \$90/bbl in 2015, \$95/bbl in 2020, and \$110/bbl in 2030.

<sup>3</sup>All these years natural gas secured more than half of national energy supply at prices several times lower than comparable prices of oil products and even coal.

<sup>4</sup>Preliminary estimates show that even such a moderate price as 10-15 Euro per ton of !•2 can significantly improve commercial attractiveness of many energy conservation measures and non-fuel energy sources.

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