

## Analysis

# Energy Efficiency and Development of Renewables: Russia's Approach

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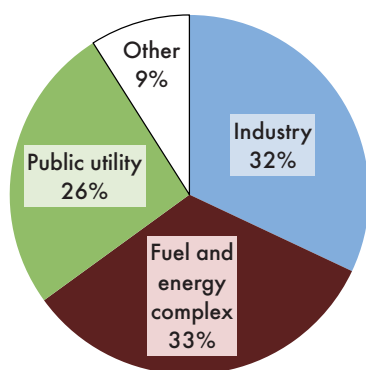
### Abstract

Russia is not only one of the leading exporters of energy, but also a major consumer. Since energy has been relatively cheap in Russia, industry and households engage in extremely wasteful practices. Plans are underway to raise domestic prices for natural gas and electricity and bring them up to European standards. Hopefully, realistic prices will push the country toward a more efficient use of energy. The threat of global warming does not drive Russian policies. Rather, the main impetus for enhancing energy efficiency is to meet rising energy demands at home and maintain, or even increase, export volumes. This article provides an overview of the challenges and problems involved in increasing energy efficiency levels in Russia, and also analyzes Russia's potential to use renewable energies. The main problem is that Russia pays considerably less attention to energy efficiency and the development of renewables than Europe or the USA. This neglect arises from Russia's massive fossil fuel reserves, which provide little stimuli for an urgent development of alternative sources and the implementation of energy efficiency measures.

### Energy Efficiency in Russia

Like many European countries, Russia considers increased energy efficiency, and consequently access to new energy-saving techniques, materials and equipment, a key element of a sustainable energy future. The potential of Russia's economy to save energy is huge. According to Russia's Energy Strategy to 2020 (approved by the Russian government in August 2003), the country has a potential to save some 360–430 million tons of oil equivalent (toe), which equals 39–47 percent of current annual energy consumption (see Figure 1).

Figure 1: Energy Saving Potential According to Russia's Energy Strategy to 2020



Source: Ministry of Industry and Trade of the Russian Federation

The Energy Strategy lists increasing energy efficiency as a key activity for the entire governmental economic policy and one of the main strategic targets. According to the Strategy, efficiency should be part of

a broad range of governmental energy policies, including the rational use of subsoil resources, the development of domestic energy markets, and improved regional and external energy policies. The liberalization of the domestic energy market, which the Strategy specifies in detail, should provide the basis for improvements in energy efficiency in Russia.

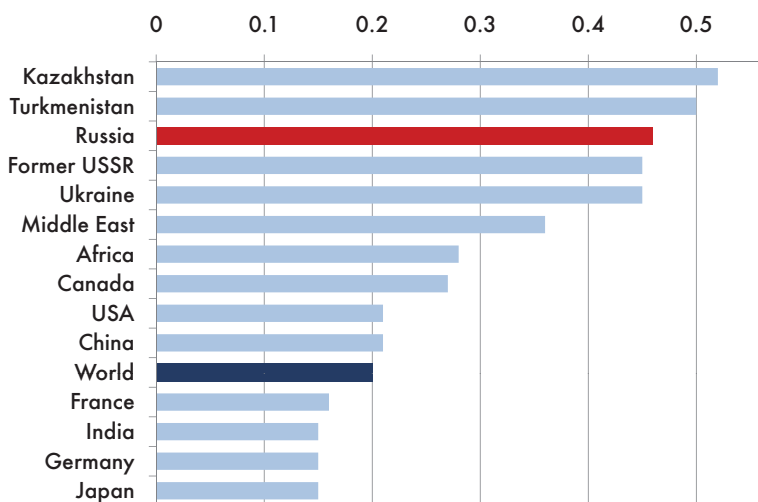
Another important element mentioned in the Energy Strategy is the development of renewable sources of energy. In April 2007, then-President Vladimir Putin in his address to the Federal Assembly highlighted that it is of great importance to elaborate and implement programs aimed at solving the task of improving the renewable sector of Russia's energy potential. In December 2007, then-Prime Minister Viktor Zubkov called 2008 the year of energy efficiency and innovations.

It is significant that more and more companies are creating sections within their enterprises which are exclusively dealing with the issue of enhancing energy efficiency. The major players in the efficiency business on the governmental level are the Ministry of Industry and Energy and the Ministry of Economic Development and Trade. At the subnational level, regional or local governments are taking the lead on these issues.

### Russian GDP Energy Intensity

Currently, Russia is among the least effective countries in using energy resources. Russia needs 2.3 times more energy to produce one unit of GDP than the world average (see Figure 2 overleaf). According to Russian government evaluations, one-third of Russian fuel-energy resources are lost or consumed inefficiently. The main reasons for such wasteful consumption are:

Figure 2: GDP Intensity in Various Countries, 2006  
(tons of oil equivalent/\$ thousand in 2000 ppp)

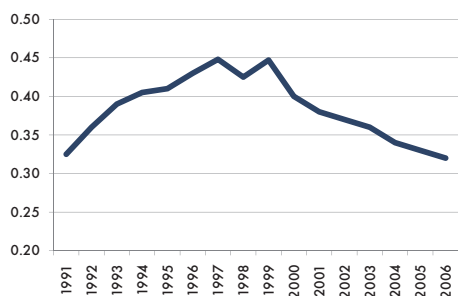


Source: IEA Key World Energy Statistics 2008

- low prices for energy resources;
- environmental and climatic conditions, particularly the low average annual temperature;
- economic structure, in which most of the economy is made up of energy-intensive operations (over 60 percent of industry), while only a relatively small share of GDP comes from the service sector, which has low energy intensity;
- outdated power technology equipment.

Russian GDP is also very gas-intensive, and low gas prices stimulate growing consumption. The efficiency of gas power units in Russia is 33 percent, while in Europe this figure is above 55 percent. In 1980–2003 gas consumption substantially grew in the public utility sector (this sector’s share in gas consumption increased from 7.9 percent in 1980 to 14 percent in 2003). Though after the peak in 1996–98, gas intensity began to go down, data from the Energy Research Institute of the Russian Academy of Sciences (ERI RAS) indicate that Russian levels are still several times higher than average global indicators (see Figure 3).

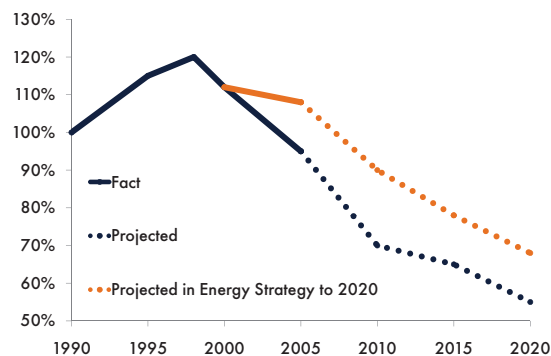
Figure 3: GDP Gas Intensity Evolution in Russia (cub. m/\$)



Source: Energy Research Institute of the Russian Academy of Sciences (ERI RAS)

Reducing energy intensity in the economy has been even more rapid in recent years than specified in the current Energy Strategy. Particularly, in 2000–06 the specific GDP energy intensity went down by 23.3 percent, according to Russian government estimates (see Figure 4). Yet this decrease in the total energy intensity of the Russian GDP was caused not so much because of specific measures undertaken by the authorities, but because of changes in the Russian economic structure, which increasingly favors less energy-intensive sectors. We may expect a further decrease within the next 2–3 years, when new pricing mechanisms, the creation of a more competitive situation on the domestic energy market, and new public-private partnership mechanisms begin to function.

Figure 4: Change in Russian GDP Energy Intensity



Source: Ministry of Industry and Energy, IEA.

### Russia’s Energy Saving Potential

Of Russia’s estimated energy saving potential (360–430 million toe), the Russian Energy Strategy to 2020 calculates that approximately 20 percent can be implemented at the relatively low cost of USD20 per ton of standard coal. The most expensive measures (at a cost exceeding USD50 dollars per ton of standard coal) comprise about 15 percent of energy-saving potential. Measures costing between 20 and 50 dollars per ton of standard coal, comprise the remaining two-thirds of the energy-saving potential and require considerable investment. The Strategy estimates that by 2020, the approximate levels of energy saving investment requirements in Russia will reach USD50–70 billion. According to the Minister of Industry and Energy Viktor Khristenko, plans are currently being elaborated which would make it possible to save 100 million toe annually by 2015.

ERI RAS estimates that about one third of all saving potential is with the fuel and energy complex, another third is concentrated in other industries and the construction sector, more than one quarter in the public

utility sector, 6–7 percent in transportation, and 3 percent in agriculture (see Table 1 below).

According to Russian government estimates, the total amount necessary to finance energy saving measures up to 2015 will comprise about RUR70 billion (USD2.86 billion), including 26.4 billion (USD1.08 billion) from the federal budget, 21.1 billion (USD0.86 billion) from regional budgets, and 22.5 billion (USD0.92 billion) from off-budget sources.

Certainly the government cannot provide enough money to meet the total investment requirements. That is why businesses interested in minimizing energy costs must provide the main contribution toward increasing energy efficiency.

### Public Utilities and Heat Saving

Decades of low energy prices caused public utilities and consumers to waste generated heat. Most Russian cities and settlements are heated by centralized heat supply systems, which consist of a heat source (CHP station or boiler house), heat supply networks, and consumers.

Russia has almost three billion square meters of housing. The heat losses which occur through windows by themselves are comparable to the entire volume of energy generated by all of Russia's nuclear power plants, according to some estimates. Considerable losses also occur during the generation and transportation of heat.

Heat consumption in Russia equals approximately 1,650 million Gcal/year (236 million toe). One half of this amount is used to provide heat supply for residential buildings. According to the Russian Ministry of Industry and Energy, increased boiler efficiency and a larger share of combined heat and power generation could reduce fuel discharge by 25 percent or 105 million toe. The aggregated heat losses in the networks amount to approximately 450 million Gcal/year (64 million toe). The saving potential through advanced heat insulation, prompt leakage repair, reduced pipelines diameters, and partial decentralization of heat supply to end consumers amounts to 300 million Gcal/year (43 million toe).

Given that Russia lacks the resources to substantially improve the insulation of its buildings to the level of most advanced countries, we may realistically assume that Russia could reduce its total heat consumption using available means by some 550 million Gcal/year (79 million toe). The total size of real savings in heat supply networks and heat consumption may be estimated at 850 million Gcal/year (121 million toe).

The Russian state seeks to provide incentives for public utilities to reduce the amount of energy they waste. The Duma is currently considering the draft law "On Heat Supply," which should establish economic and legal incentives for technical upgrade projects. In July 2007, Russia adopted the Federal Law "On the Basis for Reforming Public Utilities," which provides efficient mechanisms to manage public utility systems and financial support for the implementation of resource-saving technologies. This financial support will benefit both regional and municipal governments.

It is important to note that in the sphere of the public utilities sector, the individual Russian regions adopt their own laws. For instance, for more than ten years Moscow uses a special decree "On Using Polyurethane Foam Insulation for Heat Network Pipelines," which forbids the usage of outdated materials for municipal properties. This decree specifies both administrative and technical activities, ensuring compliance. Due to this decree, hundreds of kilometers of heat supply networks have been built in Moscow using new technology. Beyond Moscow, other large Russian cities (St. Petersburg, Samara, or Ulyanovsk) have sought to implement modern technologies. However, on a national scale, the number of such efforts is modest.

Today, people and enterprises in many regions are taking advantage of heat saving technology on their own in their homes, offices and manufacturing facilities. They are installing multiple-pane windows, heaters with adjustable output levels and constructing modern CHP plants and boiler-houses. Yet, the situation is still far from satisfactory and there need to be greater incentives in order to push consumers

Table 1: Potential of Administrative and Technical Measures of Energy Resources Saving (estimated by ERI RAS by 2000 level)

| Industries                                    | Electric power<br>(billion kWh) | Centralized Heat<br>(million Gcal) | Fuel<br>(million toe) | Total          |            |
|---|---------------------------------|------------------------------------|-----------------------|----------------|------------|
|   |                                 |                                    |                       | million toe    | %          |
| Fuel and energy complex                       | 29–35                           | 70–80                              | 99–110                | 120–135        | 33–31      |
| Including power generation<br>and heat supply | 23–28                           | 67–76                              | 70–77                 | 90–100         | 25–23      |
| Industry and construction                     | 110–135                         | 150–180                            | 49–63                 | 110–140        | 31–37      |
| Transportation                                | 7–11                            | –                                  | 22–26                 | 23–30          | 6–7        |
| Agriculture                                   | 4–5                             | 5                                  | 9–11                  | 12–15          | 3          |
| Public utility sector                         | 70–74                           | 125–135                            | 51–60                 | 95–110         | 27–26      |
| <b>Total</b>                                  | <b>220–260</b>                  | <b>350–400</b>                     | <b>230–270</b>        | <b>360–430</b> | <b>100</b> |

Source: Energy Research Institute of the Russian Academy of Sciences

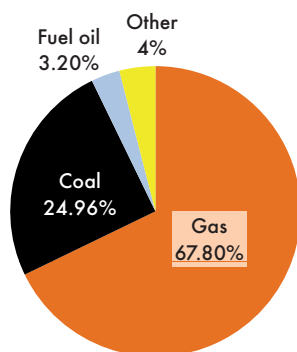
at both the federal and regional levels to implement more radical measures.

### Energy Saving in the Gas Industry

Natural gas represents over half of Russia's primary energy consumption. According to BP's 2006 Statistical Review of World Energy, Russia was second only to the USA in gas consumption. Russia used 450 billion cubic meters (bcm) or 15 percent of global production, which equals the aggregate consumption of the six largest Western European countries: the UK, Germany, France, Italy, Spain and the Netherlands. Russia's domestic gas market is 2.2 times bigger than its exports to Europe and the CIS.

Gas is also the main source of electricity generation in Russia – about 68 percent (see Figure 5). Gas began to dominate electric power generation in the 1980s, when the USSR leadership decided to temporarily replace coal with gas, allowing time for domestic engineers to prepare new, safe coal and nuclear energy technologies. This “gas pause” has continued up to the present days and is likely to continue in the future.

Figure 5: Fuel Mix of Operating Power Plants



Source: Energy Research Institute of the Russian Academy of Sciences (ERI RAS)

One company – Gazprom – dominates the gas sector and energy efficiency measures in this area. In 2001, Gazprom adopted an Energy Saving Concept for the period to 2010, which includes measures to increase efficiency at virtually every stage – from gas production, to transportation, storage, processing and distribution.

Gazprom's stated goals with regard to energy savings are: to compensate for the lack of new field production and thus make sure that enough gas will be available for domestic and international costumers, to reduce operational expenses by cutting the amount of energy consumed and thus increase the competitiveness of Russian gas, and finally, to reduce emissions of greenhouse gases and harmful substances into the air.

In compliance with the concept, Gazprom's subsidiaries and organizations carry out ongoing work

aimed to reduce their own natural gas consumption and marketable gas losses, and to save energy resources. In 2002–06, according to Gazprom data, gas producing and gas delivering affiliates of Gazprom saved 13.1 bcm of gas, 1.6 billion kilowatt-hours of electric energy and 703.9 thousand Gcal of heat energy due to the implementation of power saving technologies.

The priorities in the company's energy saving program for the period 2007–10 are even more ambitious: Gazprom wants to save 9.2 bcm of gas by 2010 and 1.212 thousand gigacalories of heat energy.

### Burning Associated Gas

Gas flaring is yet another big problem and deserves special attention. The Russian Ministry of Natural Resources estimates that 35–40 bcm of associated oil gas is flared every year. According to estimates from the International Energy Agency (IEA) calculated on the basis of satellite pictures, the actual volume might be twice as high.

Associated oil gas (AOG) is a by-product of oil production. It is often simply flared because there is no infrastructure for its collection, transportation and processing. According to the Ministry of Industry and Energy, in 2006 Russia produced 57.9 billion cubic meters of AOG, of which 24.4 percent was flared. Large oil companies produce 83 percent of this gas.

In order to ensure higher utilization of AOG, the Ministry of Natural Resources decreed that oil companies must achieve 95 percent utilization by 2011. Russia's Ministry of Industry and Energy supports similarly strict measures, but has suggested a more realistic timetable. Aleksander Savinov, the head of the regulatory control division within the ministry's oil and gas department, declared that the ministry plans “to achieve an AOG utilization level of at least 85 percent by 2012 and 95 percent by 2015.”

Russia's oil companies do not object to these government initiatives. Rosneft, which currently processes only 59 percent of its AOG, will allocate RUR67 billion (about EUR2 billion) within five years to raise the figure to 95 percent. Lukoil is going to invest RUR50 billion (EUR1.43 billion) in utilization through 2016. Lukoil currently estimates its AOG utilization level to be 75 percent. All in all, Russia's oil companies plan to invest some USD6 billion in AOG utilization over the next several years.

In the near future, the set of measures to solve AOG utilization problems may be expanded. One way is to make license agreements only on the provision that companies utilize at least 95 percent of their associated gas. At the same time, sanctions may be applied against subsurface resource users for failing to meet these targets, including the withdrawal of their license.



Some experts believe that 95 percent AOG utilization by 2011–15 in Russia is too ambitious a goal, as it took other countries decades to achieve this performance level. But there is no doubt that it is necessary to move in this direction.

### Energy Efficiency in the Electricity Sector

The power sector represents yet another area for massive energy savings. According to ERI RAS estimates of 2000, the Russian energy saving potential may amount to 220–60 billion kWh, i.e. 23–8 percent of current electricity consumption. Energy efficiency increases in the electric power industry are possible at all stages, from power generation to the sale of energy to end-consumers.

Russia must raise prices to encourage electricity savings. Consumer tariffs should reflect the real market values in a specific region. Otherwise, the need for new capacities will snowball. The average sales tariff level in the wholesale market required for the development of new generational capacity amounts to 4.6–5.6 cents/kWh by 2010, and 6.0–6.3 cents/kWh by 2020.

There is a wide range of targeted regional programs for increasing efficiency in the distribution and consumption of electricity. These projects are mainly aimed at the reconstruction of power supply and power networks, and the installation of electricity meters. Increased information about how to save electricity will also play an important role.

Some state entities, such as schools, have replaced inefficient appliances with support from federal and regional authorities. Such upgrades make it possible to reduce power consumption by more than 50 percent. Unfortunately, such programs are sporadic and experimental and do not have a serious impact on the overall situation in the industry.

### Renewable Energy Sources

Currently, the share of non-conventional energy sources in Russia's overall energy output (which equals about 991 billion kWh) is less than 1 percent. While Russia is rich in hydrocarbons, there are certain parts of the country where conditions allow for the relatively easy development of certain renewable energy sources. These are the northern coast regions with big wind energy potential, the southern regions with lots of sunshine per hour, and, of course, the regions with numerous rivers, including small ones, providing opportunities for hydropower development.

According to some evaluations, the overall potential of renewable energy sources is about 4.6 billion tons of standard coal a year, which is five times more than the total fuel-energy consumption of Russia. The economically viable potential of renewables has been

evaluated at 270 million tons of standard coal a year, which is a little more than 25 percent of Russia's annual consumption.

There are already companies in Russia that deal with wind energy, yet Russia has few large wind power systems at present. Peat and firewood are the traditional renewable energy sources in Russia, which are also most common and available to people. The Energy Strategy estimates the total peat reserves in Russia at 162.7 billion tons (at 40 percent humidity). The richest regions are the northern areas of the European part of the country, the Urals, Western Siberia and the North-West. Given appropriate conditions, peat reserves may be renewable. The annual peat growth rate in Russian marshes is 250 million tons. The peat reserves within the developed fields allow production equivalent to 7 percent of annual coal consumption.

Due to the low labor and energy intensity of peat production, simple transportation routes and small distances of transportation, peat remains competitive in some regions, compared to other imported solid fuels. Moreover, peat features low content of pitch and serum, which produces few harmful emissions during burning. In 2000, Russian power plants used 1.7 million tons of peat.

Firewood is now used by 5 million households, consuming over 50 million cubic meters of timber. Within the framework of centralized sales, fuel-supply enterprises sell about 6 million cubic meters of timber. It is necessary to maintain the existing capacities for firewood preparation and create new ones on the basis of forestry, timber industry and fuel enterprises.

Urban domestic wastes, particularly as a source of biogas, are an important local fuel. Unlike biogas production in agriculture, urban enterprises for solid domestic waste (SDW) utilization possess the necessary financial and technical foundation to equip SDW landfills with equipment to collect and use the biogas.

In mid-October 2007, Tatarstan President Mintimer Shaimiev announced the construction of a biofuel plant – the first of its kind in Russia. The plant will annually process more than 1 million tons of grain. Rye, wheat and corn will be the raw materials for the plant. According to State Duma Speaker Boris Gryzlov, today Russia could use 14 million tons of grain for bio-energy sector development.

The poor legal framework partly explains the slow development of non-conventional energy sources in Russia. However, in 2006 the Ministry of Industry and Energy, together with RAO UES, the electricity monopoly, proposed a draft law "On the Use of Renewable Energy Sources in the Russian Federation." The draft law contains a mechanism for governmental support of development in this important sector. As estimat-

ed by the Ministry of Industry and Energy, if the proposed law is adopted and its programs implemented, the share of renewables in the overall energy balance may reach 3–5 percent as early as 2015, and increase up to 10 percent in 2020.

The most accelerated growth of renewable sources is expected in the field of wind and hydro energy (especially small-sized power plants). The main investors in renewable energy are expected to come from small and medium-sized enterprises, located where connection to public electric networks is either impossible or expensive.

### What Stimulates Energy Saving?

While there is growing awareness of the need to promote energy efficiency measures and renewable energy sources, many federal and regional initiatives remain on paper. What will drive improved energy-intensity levels are not administrative and technical measures, but the fact that Russia's economy is in the process of a profound transformation. Such changes are visible in the priority development of less energy-intensive industries (particularly, trading and services) and the accelerated growth of less energy-intensive industrial production.

As a result of all energy saving factors, according to Russia's Energy Strategy to 2020, the total GDP energy intensity will go down between 2005 and 2030 by 1.6 times in the moderate and 2 times in the optimistic scenario. The GDP electricity intensity will go down in 2005–20 by 1.4 times in the moderate scenario (slower

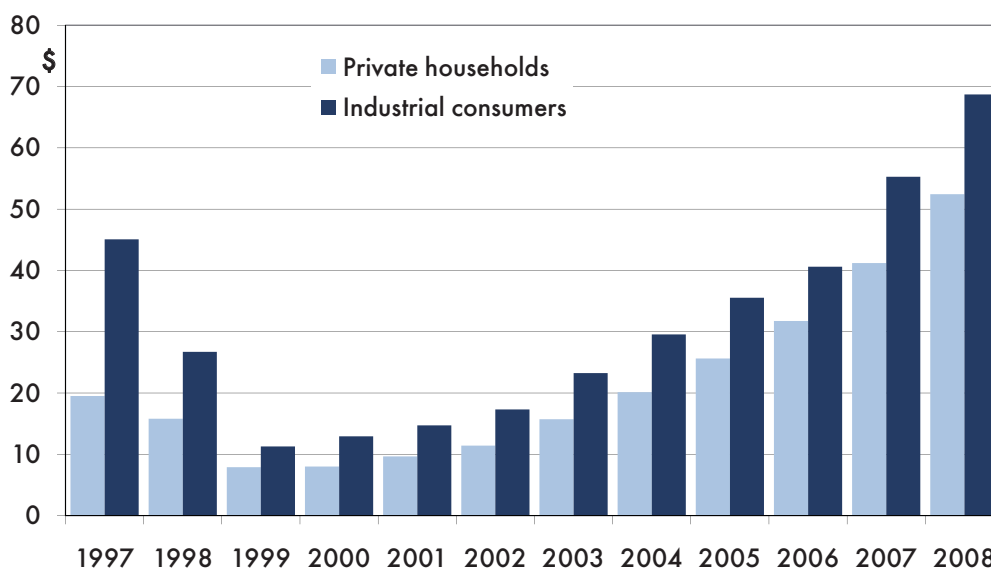
than the total energy intensity), and by more than 2 times (faster than the total energy intensity) in the optimistic scenario, which can be explained by varying rates of increased electrification.

Higher prices is another incentive for energy savings. In this regard, the decision of the Russian government to increase domestic gas prices is important. The government plans to increase the gas price up to the level where sales to domestic and foreign markets are equally profitable, using long-term five-year contracts with electric power organizations, and resolutions ordering the increase of the electricity share which should be sold at non-regulated prices. The gradual implementation of these measures should be completed by 2015 (see Figure 6).

Another key element is demand management, which is actively used in foreign countries. Its main idea is the creation of economic consumer incentives to reduce energy consumption, particularly at the moments of peak load, thus lowering the need for generating capacities. The most common ways to achieve these goals include installing meters and introducing differentiated tariffs with variable rates for periods of peak and low loads, as well as using interruptible energy supply contracts, which make it possible to lower the load or disconnect consumers during peak hours.

Apart from this, administrative measures, such as regulations for equipment efficiency and building codes, are needed to restrain wasteful consumption. According to estimates by the Ministry of Industry and Energy, the development and introduction of prospec-

Figure 6: Russian Average Regulated Gas Tariffs



Sources: JSC Gazprom, orders of Federal Tariff Service.

tive regulations, standards and procedures in the near future will make it possible to reduce hydrocarbon production losses by 15 percent, while new control and accounting systems will assist energy resource consumption by 10–15 percent.

To stimulate energy savings, a sophisticated governmental policy is needed. The federal five-year program “Energy Efficient Russia” expired in 2006, a new program is now under development. In April 1996, Russia adopted the Federal Law “On Energy Saving” which is currently being revised. There are already 45 regional laws “On Energy Saving,” but it is necessary to conduct further work at all levels to increase the energy efficiency of the Russian economy.

Informational support plays an important role in the implementation of energy and gas saving programs. A dearth of reliable, unbiased information prevents people from purchasing energy efficient equipment and applying saving measures.

Currently, the Russian government is elaborating a range of financial incentives (including taxes) to encourage energy saving. This effort is taking into account both international experience and the results of such activities in Russia at the regional level.

### Prospects of International Cooperation in Energy Saving

Presently, Russia is actively cooperating on issues related to increasing energy efficiency, both multilaterally (within the EU-Russia energy dialogue, within the G8) and bilaterally. In 2006, a Memorandum of Cooperation in Energy Efficiency was signed between the Ministry of the Economy of the Netherlands and the Ministry of Industry and Energy of the Russian Federation. The Joint Energy Efficiency Working Group of the Russian Ministry of Industry and Energy and the US Department of Energy has been at work for ten years. In 2007, a Russian-German Energy Efficiency Forum took place in Moscow.

Giving special attention to energy efficiency as a critical instrument for reducing the energy intensity of Russia’s economy and ensuring energy security, Russia and the EU in 2000 decided to launch a regular “Energy Dialogue.” In February 2006, the coor-

dinators of the Energy Dialogue (Russian Minister of Industry and Energy Viktor Khristenko and EU Energy Commissioner Andris Piebalgs) put forward a joint energy efficiency initiative. Specific implementation measures were discussed by Russian and European experts at a seminar in Moscow on October 26, 2006, and at a conference of energy agencies and energy saving centers in Kazan on December 6, 2006.

An important element of joint work with other countries is the implementation of the Kyoto Protocol, which provides Russia with two main sources of investment to be used for energy saving needs. First, these are joint implementation projects, when foreign companies, restricted by emission limits, invest in projects in other countries (with considerably lower costs) and receive, in turn, the rights for increased emissions. The second mechanism is international emission trading. Russia, which currently has a great reserve of such quotas, may transfer them to other countries and obtain funds for the implementation of priority energy-saving programs.

The mechanisms have already begun to be used. In late 2006 Gazprom Marketing & Trading carried out the first transaction in the European CO<sub>2</sub> emissions trading market. The deal with Deeside Power Limited involved gas sales and CO<sub>2</sub> emission permissions in exchange for electric power.

In 2007, RWE AG (Germany) signed a contract to improve energy efficiency at the Russian electricity company EES Rossii in exchange for access to Russia’s emissions trading market. In the near future, Russian and foreign companies may achieve a new level of cooperation concerning projects focused on joint implementation and emissions trading mechanisms. This should be supported by the implementation of cutting-edge energy-saving technologies.

There is no doubt that the growing energy efficiency of the Russian economy will increase the robustness of the global energy system, reduce development risks and make it more sustainable. Russia’s growing involvement in international cooperation will promote more effective energy dialogue in the fields of energy resources supply, scientific and technical progress and the environment.

#### *About the author*

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