TOWARDS A SUSTAINABLE RUSSIA

ECOLOGY AND ENERGY

CONTENTS

ON THE IMPORTANCE OF ENERGY SAVING

The Russian economy had been dying until 1998. This happened in the absence of any shifts in the real sector of the economy. Only the 1998 default called into economic life forces that were able to start doing something in this real sector. Now only the fluctuations of world oil prices bring material changes in the economic structure of the Russian Federation, as, before that, of the Soviet Union, if we take a period beginning from the mid-1960s.

Government meetings gather people that seem to be vested with power and decision making. Everyone agrees to sound proposals voiced in favor of energy saving, and absolutely no one says «no». Perhaps, the minister of finance keeps humble silence; the rest of them say «yes». Nothing happens afterwards. This is called an intellectual deadlock. Although nobody needs long persuasions and many arguments to understand that energy saving is of colossal importance for Russia.

Everybody knows for sure that the energy intensity of Russia's GDP exceeds more than three times that of the EU countries. The favorite topic of those who try to make excuses is that this state of affairs is due to the extreme severity of Russian climate.

Sverdlovsk oblast, a leader in energy saving, has achieved a wonderful result, having conducted the following survey. There is a climate severity index. It is objective. For the United States, it is 2700; for Sweden, 4020; for Finland, 4120; and for Russia, 5000. If we take the United States as a unit, then Sweden and Finland will be assessed at about 1.5, and Russia, at 1.85, on the one hand. On the other hand, there are data about the production of cubic meters of heat insulation per 1000 people a year. Therefore, the United States annually produces 500 m^3 of heat insulation per 1000 people; Sweden, 600 m^3; Finland, 420 m^3 (probably, because it was part of the Russian Empire in the past), and Russia, 90 m^3. This gives a different tint to the severity of our climate. Just think about it: Russia produces 90, and the United States, 500 m^3! If we calculate with allowance for the climate severity index, then the United States will still have 500; Sweden, 400; Finland, 276; and the Russian Federation, 48. If this value is also normalized, then we will get what may be conditionally called the energy concern index relative to the Unites States. Therefore, it is 1 for the United States, because this country was assumed as a unit of scale; 0.8 for Sweden; 0.55 for Finland; and 0.1 for Russia.

Calculations show that, in Russia, energy overconsumption due to climate severity must not exceed 30 % relative to Europe. Yet it is 3.1 times higher. The rest is spent on heating universal space and can be regarded as a mere payment for elementary wastefulness.

Of course, it is unreal to expect that Russia will have such prices for energy carriers that will make the population rush to save energy and «tear to pieces» those managers who do not encourage energy saving. No powers in Russia will ever set such prices. Such prices can be established only due to external factors. Unfortunately, our population and our economic managers should be trained for that. The first step in this direction could be the adoption of a special law on propaganda of energy saving.

The words political will have been pronounced very often lately, unlike the words hydrogen energy. Yet nothing happens after pronouncing the words political will, absolutely nothing. For Russia to shake up, as its history shows, very serious and deep changes are needed in civil consciousness.

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ECONOMIC POLICY AND ENERGY SECURITY

A crucial topic at G8 summits and in talks between Russia and the European Community and individual countries is the problem of energy security. Most often this problem is formulated as providing all countries of the world with reliable supply of energy resources. Obviously, countries that import energy resources are interested in encouraging Russia into becoming a global energy donor by increasing the extraction of its energy resources. In the same key are the latest decisions of the Russian authorities to increase by two-thirds the production of electric power by 2020 and to build 26 nuclear power units in the next 12 years, as well as new large hydropower plants in Siberia and the Far East. In other words, provision is made for largely extensive growth of the energy sector.

Yet, how efficient is this way and does it correspond to Russia's interests and energy security?

We think that energy security for Russia must include at least three components: stable provision with energy resources for its own development, gaining the maximum economic benefits from its energy resources, and the reduction of the energy sector's impacts on the environment.

First, before increasing the sales of energy resources, we should think about ourselves. According to the estimates of the Russian Ministry of Natural Resources, profitable oil reserves in the country will be depleted by 2015. Then everything will be very expensive – the shelves of the Barents Sea and Sakhalin and the Siberian permafrost. Tens of billions of dollars of investments are already needed now to develop these fields. What if the world market prices drop? Maybe, it would be more profitable to buy the Middle Eastern oil, whose cost is 3–5 times lower than the cost of Russian northern and shelf oil, and this gap will continue to grow. The United States thinks about its energy security; conserves many fields, particularly in Alaska; creates strategic oil reserves; and imports a lot.

It is also important to determine clearly how to ensure the energy basis for the country's development in the future. Theoretically, there are at least two answers: to increase the gross production of energy carriers or to use reserves. While the Russian economy is in transition, it is obviously necessary to orient the development of the energy industry toward end results and not toward intermediate results, such as the extraction of energy resources and the production of energy and heat. Should we strive to produce more? The energy-intensive and backward structure of our economy itself is a huge alternative deposit of energy resources, from which hundreds of millions of tons can be extracted annually. We may say that the main reserves of the country's energy resources are located in the European part of Russia, where, formally, deposits of oil, gas, and coal are minimal. However, there is located the overwhelming part of industrial, energy, utility, and transportation facilities, which, due to obsolete technologies, overconsume and waste hundreds of millions of tons of valuable raw materials. According to Russia's Energy Strategy until 2020 (2003), pretty simple measures can save 40–45% of domestically consumed energy resources. This is the very source from which the country may take energy resources for its development over the next 10–15 years.

Our society and power structures must clearly realize that the main deposit of energy resources in the country is in the sphere of energy saving, from which we can take huge reserves for development, consumption, and export. This must be the focus of the country's economic policy. Russia should not dream about global energy donorship. The country must think about its own economic benefits and what to leave to its children and grandchildren.

Second, we must strive to get the maximum economic gain from our energy resources. Now Russia annually loses tens of billions of dollars owing to excessive energy consumption and sales of unprocessed primary stock with a low value added. The economy's technological restructuring will make it possible to reduce significantly the total demand for energy resources and energy intensity. According to the estimates of British experts, Russia annually loses more «foregone exports» than the total energy consumption of Britain, the world's fourth economy, which is 250 million tons of oil equivalent, or tens of billions of dollars[1] (!). In other words, Russia can stabilize or even reduce its current extraction of energy resources and still develop successfully by reducing its domestic consumption and renovating its energy-saving structures.

In the opinion of V.I. Danilov-Danil'yan, Russian energy intensity, which reflects energy costs per GDP unit, must only be 25–30% higher than in European countries and not 3 times higher on average, as it is now. A characteristic example is Norway, which, being a northern country, like Russia, has large energy resources, but, at the same time, its energy intensity is 3.3 times lower. In other words, the current extraction of energy resources would be enough to triple Russia's GDP.

Colossal reserves for technological improvements and innovative development in energy consumption are mentioned in the well-known report Factor Four to the Club of Rome[2]. The report showed how to double production and halve resource use. In addition, specific technologies were given for obtaining such results. Thus, the current industrial infrastructure makes it possible to halve global energy consumption, and, a new infrastructure based on the existing technologies can reduce it 90%. For Russia, this means that, for example, energy consumption can be reduced 3–6 times on the basis of traditional (not even latest) western technologies, while end results will still grow.

It is noteworthy that, in terms of replenishing the budgets of the country and energy companies, possible general stabilization/reduction of extraction of energy resources due to internal energy saving may significantly increase the incomes of the country and individual companies by increasing the export of energy resources, improving processing, and diversifying production. Thus, according to the available estimates, the cost of crude oil converted into petrochemical products increases 6–10 times[3]. The paradoxical thesis «to produce more without extracting more» is quite topical for today's economic policy. For Russian energy companies, such a way does not require a radical change in their structure and management, since they are already vertically integrated structures and cover the whole chain from extraction to marketing. It is the government that must form a new type of development of the raw-material sector and oblige companies to do this, because it represents the interests of contemporary society as a whole and those of future generations.

Third, the country's energy security must be closely related to environmental security and the reduction of energy impacts on the environment. As noted above, we must try to obtain the maximum economic gain from our energy resources when lifting off environmental loads, that is, to conduct a «double victory» policy. The factor of symmetry between increased energy efficiency (rationalized use of energy resources) and the implementation of environmental effects (reduction of environmental loads) is very important here.

The energy sector is the largest contaminator, discharging about 50% of all hazardous substances into the country's atmosphere, 20% of polluted waste waters, more than 30% of solid industrial wastes, and up to 70% of all greenhouse gases. We must clearly understand the dual consequences of development of the country's energy sector: on the one hand, it provides energy for economic development, but on the other, virgin territories with giant reserves of oil and gas play a crucial role in the stability of the global biosphere. Therefore, the grandiose plans of expanding extraction in the northern territories (Yamal, etc.) and shelves (Sakhalin, the Barents Sea) will lead to the destruction of undisturbed ecosystems on vast territories with unclear environmental consequences not only for the country alone but also for the whole world (climate changes as a result of swamp and forest degradation, reduced biodiversity, pollution of seas, etc.). The country may lose the major part of its global ecosystem/environmental services.

Over the past years, many oil pipeline emergencies have occurred in Western Siberia, the Komi republics, Bashkortostan, Tatarstan, and Middle and Lower Volga regions. The main cause of emergencies is the physical wear and metal corrosion of the main and internal oil and gas pipelines. As a result, natural ecosystems are being destroyed on vast territories. According to some estimates, tens of millions of hectares of tundra degraded in recent years as a result of soil and vegetation cover destruction by mining and exploration works, extensive extraction of mineral resources, transportation, and construction. These are great losses for the global ecosystem.

Ensuring the country's real energy security requires clear identification and implementation by the government of long-term goals of transition to the country's postindustrial economy and sustainable development. Energy strategies, programs, and plans, which envisage transfer to energy saving and significant reduction of energy intensity, have been adopted for ten years now. Yet with each year the Russian economy becomes more and more oriented toward raw ma-

[1] The OTAS Co. (www.rusgrowth.com)

[2] E.U. von Weizsäcker, A. Lovins, and H. Lovins, FACTOR FOUR: Doubling Wealth, Halving Resource Use (Earthscan, London, 1997).

[3] A.N. Spartak, Russia in International Labor Division: Choosing a Competitive Strategy (MAKS Press, Moscow, 2004), p. 324 [in Russian].

terials. We must act. The important fact is that Russia's power structures realize the necessity of changes in the economic path. The thesis that necessitates the departure from a raw-material economy, the diversification of the economy, and its transfer to an innovative and science-intensive economy has been often repeated by the Russian president and members of the Russian government in recent years. This road must obviously take us to economic restructuring and significant energy saving. The relevant mechanisms are necessary. Here, we do not need technological superinnovations and huge investments. All developed countries have already been implementing energy saving and technological restructuring for more than 30 years. Their results are very impressive: great reduction of energy intensity together with significant GDP growth, colossal economy of energy resources, and drastic reduction of environmental pollution.

Incidentally, many CIS countries (Ukraine, Belarus, Georgia, and others) must thank Russia for the sharp increase in prices for energy sources, which makes restructuring for energy saving and departure from a primitive and material-intensive economy inevitable for them. Who will push Russia? Hopes pinned on the Kyoto Protocol, ratified by Russia, which, in particular, must limit primitive energy-intensive development, are illusory: Russia has too great a reserve for energy consumption growth by the Kyoto commitments. While increase in energy production is supported by many lobbies (oil, gas, nuclear, electricity-producing, etc.), energy saving has no real support group in business, power structures, and society. Therefore, the crucial slogan of our society and environmental movement must be: «Go foe energy saving!»

The government must also envisage the formation of energy security mechanisms. In particular, it is necessary to improve control over the technology of energy resource extraction – now companies skim the cream off and extract only 30% of reserves in deposits; this index was 50% in the Soviet Union. Tax changes are also needed. With regard to long-term sustainability, it is advisable to introduce higher taxes on crude oil (energy resources) extraction and reduce taxes for the processors and diversifiers of energy resources. Export duties on primary stock should also be increased, and benefits must be introduced for the export of products with a high value added. Many countries have introduced higher duties or even banned the export of primary unprocessed raw materials. The Russian president stressed the necessity of such measures for forest resources.

A criterion of success of an economic policy in the energy sphere may be the energy intensity index. This index is not only a priority for ensuring environmental sustainability but is also such for the country's economy as a whole. Here, we may single out several items:

- the leading role of the energy sector in the Russian economy, in the formation of GDP, taxes, budgetary revenues, employment, and export incomes;
- the greatest contribution of the energy sector to the pollution of Russia's environment, depletion of natural resources, and degradation of vast virgin territories;
- the energy industry's huge impact on human health;
- the energy intensity index is a representative indicator of sustainable development, which reflects both economic and environmental aspects;
- in the long-term outlook, the energy sector will continue to play an important role in the economy under the plans to increase the production of energy resources, which will probably increase the anthropogenic impact on the environment; and
- the necessity to reduce significantly the economy's energy intensity and to implement energy-saving programs.

A paradox of our statistics lies in the fact that this, probably the most crucial for Russia, index of sustainable development is not officially published by the Russian Committee for Statistics for the country and its regions. It is present in different energy strategies and programs, in the documents of ministries and departments, but the methods of calculating it and their comparability are unclear. Obviously, it is necessary to publish the energy intensity index in all official statistical documents, as it is done in many countries. A decrease in this index must indicate movement to more environmentally sustainable development and improvements in the economy's efficiency. In the 1990s, energy intensity was growing in the country; now, according to available evaluations, it decreases 2–3% a year. Its actual reduction may be even slower if we take into account the huge component of skyrocketing oil prices in the GDP growth. According to the optimistic scenario of the Energy Strategy, energy intensity can be reduced 45% by 2015 and 58% by 2020. Such reduction rates of this index are absolutely unattainable under the current trends.

Thus, both our society and power structures must clearly realize that the main deposit of energy resources in the country is in the sphere of energy saving, from which we can take huge reserves for development, consumption, and export. This must be the focus of the country's economic policy. Russia should not dream about global energy donorship. The country must think about its own economic benefits and what to leave to its children and grandchildren.

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ENVIRONMENTAL PROTECTION AND ENERGY: THE ROLE OF RUSSIAN BUSINESS, TOPICAL ISSUES, AND PARTICIPANTS

The topicality of ecologizing the conscience and practice of representatives of society needs no proofs. In particular, the condition of the environment and the rational use of natural resources largely depend on the management and personnel of large economically active agents. This material is aimed toward identifying optimal tactical approaches and subordinating them to the achievement of strategic goals.

On August 16, 2005, Kofi Annan in his report on the UN work said that «The alignment of corporate activities with broader United Nations goals has also brought about significant improvements in governance and capacity-building for suppliers and small enterprises. By advocating universal principles as an integral part of business strategies and operations, global markets have become more robust and inclusive». (section 217, ch. VI «Global Constituencies. Engaging the Business Community"). The UN Secretary General also mentioned in this report the urgency of poverty and environmental projects and the importance of implementing a global response to climate change and of developing new and sustainable energy sources (sections 55–57, ch. II «Development. Ensuring Environmental Sustainability").

In 2005, the then ICC-WBO Chairman Yong Sung Park, on behalf of the world business community, conveyed to the Head of the Gleneagles Summit Tony Blair a statement to the G8 leaders, which paid special attention to the problem of climate change. In the 2006 statement to Russian President V.V. Putin, ICC-WBO called on the leading developed economies to assess energy sources with regard to their environmental impacts. Two of the four proposed ways of ensuring energy security are related to environmental protection. First, it is the encouragement of technological innovations in energy generation, i.e., the introduction of more productive and environmentally friendly facilities. Second, it is the improved efficiency of energy use and economy among producers and consumers.

T.V. Monaghan, general secretary of the ICC-WBO Russian National Committee, in her opening speech at the international conference «Energy Stability Factors of the Russian Economy» December 5, 2006, put a question point blank: «Russia pays too high a price for its extremely low energy efficiency. It still cannot get rid of the stereotype of solving the problem of energy deficit by increasing production. Russia has neither government bodies to coordinate improvements in energy efficiency, nor a target policy, nor a developed legal framework for this."

The leaders of state regulatory bodies for the environmental and technological security of the G8 countries and the EU representatives agreed on the Resume of Chairman – K.B. Pulikovskii at their meeting on March 24, 2006. The discussion of global energy security issues was attended by other Russian ministries and departments and the representatives of different sectors of society.

Putin held a press conference July 17, 2006, on the results of the summit of the G8 state and government heads, where he said, «We have worked out uniform approaches to ensure global energy security. Our joint strategy is based on uniform understanding that humanity has common energy future. The future for which we all are jointly and severally liable. Let me stress that the decisions made allow us to ensure a long-term improvement

What should society's next step to the victory of the environmental imperative be? What should society's next step to establishing the priority of public environmental interests over private economic interests be?

It may be such as stated below.

A crucial instrument of modern information society is «soft» law in the sphere of environmental protection and energy generation. In addition to international environmental organizations, international organizations of business circles are also keen on environmental issues. They adopt activity rules that have recommendatory power for organization members. The rules may contain ecologized, raw-material, and energy-saving provisions. One of the largest associations is The International Chamber of Commerce – the World Business Organization (ICC-WBO)[1]. Its ecologized rules may become the basis for a large-scale environmental shift in Russia's economy.

[1] International Chamber of Commerce 38, Cours Albert 1er, 75008 Paris, France. Telephone: +33 1 49 53 28 28; Fax: +33 1 49 53 28 59. Website: www.iccwbo.org E-mail icc@iccwbo.org The Russian National Committee of the International Chamber of Commerce – the World Business Organization 109240, Moscow, Kotel'nicheskaya naberezhnaya 17. Telephone: +7 495 720 5080; Fax: +7 495 720 5081. Website: www.iccwbo.ru; E-mail yuri_popov@iccwbo.ru

in the global system of energy security, and, which is no less important, to cover practically all of its aspects. These are the improved reliability of the energy infrastructure, diversification of production and resource supplies, and the development of energy-saving technologies and alternative energy sources. This is obtaining a better transparency and predictability of energy markets, based on meeting the interests of all players in the global energy chain."

Speaking about environmental security, UN Deputy Secretary General and UNEP Executive Director Achim Steiner also stressed that the introduction of cleaner technologies and the use of renewable energy resources bring closer the goals of economic development and the environmental and social goals of society.

The ICC-WBO Environmental and Energy Commission expresses the stand of world business in economic industries on interindustry issues.

The main thematic areas of the commission's work are:

- genetic resources, the joint use of the benefits of access to genetic resources (ABS), handling genetically modified organisms (GMO), support for activities within the ICC-WBO commissions on intellectual property (IP), biotechnologies, and biocommunity);
- climate change;
- handling chemicals;
- energy generation;
- sustainable development (including the sustainable consumption model); and
- aquatic resources.

International forums and processes in which the ICC-WBO Environmental and Energy Commission is most active are the Global Agreement, UN Sustainable Development Commission (UNSDC), UN Development Program (UNDP), UN Environmental Program (UNEP), UN Framework Convention on Climate Change (UNFCCC), and some others. The commission's largest initiatives and special projects are «Business Actions in the Energy Field», «Business Actions in the Field of Aquatic Resources», «The Company's Environmental Package», «World Business Prize», and «World Trade Law Institute Prize."

Under the commission, there are workgroups on climate change, on trade and environment, on insurance and environmental protection.

The world community, countries, and world business have established goals that can only be achieved jointly. Making the life of millions better and approaching the solution to the global environmental problem are impossible without the participation of Russia and its business circles. Time has come to institutionalize the activity of the ICC-WBO Russian National Committee in the field of environmental protection and energy generation and to create a subject commission with an action program that accounts for Russian realities. Today, industry, agriculture, commerce, the banking sector, and the whole Russian society primarily need:

- to use energy- and resource-saving reserves (by all the players in the «chain" – producers and consumers);
- to develop science, improve and introduce environmentally cleaner technologies, including alternative and environmentally friendly energy generation – to diversify sources.

It is encouraging that these goals have been adopted and are supported by world business. The above goals are reached by implementing the ICC-WBO documents.

Based, on the one hand, on international environmental law (IEL) and, on the other hand, on international trade law and other industrial laws, the development and application of the «soft» ICC-WBO law – the doctrine of corporate environmentalism and mechanisms of making voluntary environmental commitments by business circles – are optimal for the formation of a social and environmentally oriented image of enterprises, agricultural producers, and credit institutions. If economic giants become more environmentally friendly by an iota, everyone will win.

The commission's work within the so-called Joint Use of Advantages of Access to Genetic resources (ABS) and GMO handling is related to support for applied R&D with a long-term target of increasing the asset value of investors. The beginning of work in this field in Russia may be aimed toward the development of ABS institutes – usage stereotype change, preliminary approvals, etc.; the introduction of voluntary practice codes; the dissemination of SITES certificates for in situ types. Under the UN Biological Diversity Convention, measures for its implementation must include the definition of communities of indigenous and small peoples, with whom consultations are possible. The Bonn Guidelines on Access to Genetic Resources and Fair and Equitable Sharing of the Benefits Arising out of their Utilization, other ICC-WBO documents, and the 1991 agreement between the government of Costa Rica and Merck & Co. on the exclusive right to study and the priority to patent innovations in exchange for support for state science and on royalties for commercialized innovations may be useful in this process. Interested Russian companies must take part in discussing the International Treaty on Plant Genetic Resources (ITPGR) in food and agriculture and the model standardized Material Transfer Agreement (sMTA). Among the main actors in this sphere are the UN Food and Agriculture Organization (FAO), forums dedicated to intellectual property issues, the World Trade Organization (WTO) Council on Trade Related Intellectual Property System aspects (TRIPS), the World Intellectual Property Organization (WIPO), the International Union for the Protection of New Varieties of Plants (UPOV), and other organizations. There is a need to coordinate interaction with the ICC-WBO core commissions. In Russia, the Ministry of Agriculture, the Federal Institute of Industrial Property (Rospatent), the Government Commission on Intellectual Property, and other institutions correspond to the above international organizations.

The first step of the ICC-WBO Russian National Committee may be the organization of a register of producers and products safe for the consumer and the establishment and award of a voluntary compliance certification sign. These measures will serve the goals of customer protection and market liberalization. At the next Party Conference (PC) of the Biological Diversity Convention, it is advisable to present the stand of world business and the work conducted in Russia, since we have to catch up with developed countries in this respect; the market potential is not used.

It is possible to unite and coordinate the efforts of more than 100 commissions on biosecurity at Russian academic, scientific, and commercial organizations on the basis of the ICC-WBO stand within the framework of the Cartagena Protocol to the Biological Diversity Convention.

As for the promotion of legal and regulatory framework for ABS and GMO handling, it is advisable to consider the necessity of amending and supplementing the Russian legislation and preparing and adopting regulatory acts On Seed Certification; On Foodstuffs, Medications, and Cosmetics; On Insecticides, Fungicides, and Rodenticides; On Control over Toxic Substances; and, especially, On Plant Parasites and On Weed Vegetation; on liability for damages to specific (taxonomic), environmental, and genetic diversity; and on methods of calculating it. The practices of the Interdepartmental Commission on Gene Engineering Problems and the Expert Council on Biosecurity Issues seem advisable for these purposes. We will need involvement of a number of ministries and departments and interaction with the Organization for Economic Cooperation and Development (OECD), the International Union for the Conservation of Nature (IUCN), the International Center for Trade and Sustainable Development, the International Center for Comparative Environmental Law, the International Commission for Gene Engineering and other domestic and international organizations to account for results of their activity in Russia on biosecurity issues.

Within the framework of the Commission «Climate Change and Energy Generation», we see the following three issues as the most topical for Russia.

Promoting the mechanism of transferable sales units is related to the participation in the preparation of the ICC-WBO position at the third meeting of auxiliary bodies and the next UN FCCC PC in Indonesia; within the EU-Russia Dialogue. Its goal is to assist the interdepartmental commission on the implementation of the Kyoto Protocol mechanisms in establishing sales units. To this end, it seems advisable to create, under the UNSDC procedures and with regard to the G8 summit results, the International Partnership to Ensure Environmental and Technological Security of Energy Generation with its secretariat based at a Russian enterprise or organization.

Forest reclamation and reproduction within the framework of the existing UNEP and the World Wildlife Foundation (WWF) programs and other forest reclamation initiatives help form the ecologized image of commercial enterprises and their associations. The amount of program expenditures is related to the number of trees and hectares of reclaimed forest. These figures will be clear for the public and will be the best argument against criticism. At the same time, it is especially important to envisage survival measures for seedlings, inform the public of these measures, and annually inform society of the number of live trees.

Reduction of specific fuel consumption is related to the renewal and improvement of heat and power plant facilities; installation of state-of-the-art gas traps; efficient heat supply, transfer, and utilization; introduction of alternative and renewable energy sources; and clear and loud support for nuclear generation. Also noteworthy are the British legislative practices of creating «clean air reserves», initially in individual municipalities.

The head Russian body in this sphere is the Federal Service for Hydrometeorology and Environmental Monitoring (Roshydromet). Leading international political and economic ministries and departments take part in regulating this sphere of social and international relations: the Russian Foreign Ministry; the Russian Federal Service for Environmental, Technological, and Nuclear Monitoring (Rostekhnadzor), the Russian Ministry of Economic Development and Trade, the Russian Ministry of Natural Resources, the Ural Research Institute Ecology (Perm); and others. It is necessary to coordinate the interaction of interested Russian companies with the ICC-WBO workgroup on climate change's chief Nick Campbell, the program «Business Actions in the Energy Sphere». As for the issues of discharge control and monitoring, special functions have been imposed on Rostekhnadzor and its subordinate Research Institute Atmosphere (St. Petersburg).

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ENERGY AS AN OBJECT OF LEGAL REGULATION

I will speak about law, not about environmental law but about energy law. I have been teaching the special course «Energy Law» at the Law Faculty of Moscow State University for more than ten years. What does it meant?
Energy law is an exotic notion today not only for specialists in other spheres of knowledge but even for the majority of lawyers. This is quite natural, because new «sociality layers» (RAS Corresponding Member, Prof. S.S. Alekseev) require new legal structural formations, which, like everything new, inspire certain antagonism at initial stages.

Thus, if the 20th century, in these terms, may be called the time of the origin and formation of environmental law (since the mid-1950s), when this notion – environmental law — was also related to «exotic» spheres, then energy law is a problem posed in all its totality and complexity by the 21st century. Although it is fair to say that energy law first started to be discussed in the United States in the 1970s after the «Arab embargo» and then in countries of [Western] Europe, the overwhelming majority of which are members of the European Union. Note that half a century ago, postwar and destroyed Europe was primarily concerned with providing energy for its development. As a result, the European Coal and Steel Community – the forerunner of the European Economic Community – was established, which is now the European Union, whose 50th anniversary we are celebrating these days (the spring of 2007)[1].

So, what is energy law?

Let us begin with a very simple notion of energy. What is energy? Energy, everybody says it, but few know what it means. Lawyers operate with clearly defined notions.

Analyze all our legislation, and you will nowhere find this notion. I understand that, with scientific and technological progress, figuratively speaking, this notion has been crystallizing. However, what do we regulate? The current Russian Civil Code (art. 128 «Objects of Civil Rights") enumerates the objects of civil rights but does not indicate energy as such (object). Scientific legal literature presents different points of view, which one way or another explains the particulars of legal regulation of such a specific object of civil rights as energy. In my opinion, the most correct way would be to include energy into the independent objects of civil rights, which is, no doubt, a material good (value, economic benefit – Prof. S.M. Korneev) but not a thing. It does not even fall under any other property, as V.A. Belov suggests treating it[2].

The inclusion of energy as an independent object into civil rights, alongside the restoration of the truth, would, among other things, create a legislative impulse to intensify research into legal energy relations. At present, we have a paradoxical situation: energy is regulated by civil law as its object. Yet the classical theory of civil law holds that its objects are things and rights. And nothing else! The legislator also sets things and rights as objects of civil rights in art. 128 of the Civil Code. The list of things enumerated in art. 128 of the Russian Civil Code is not complete, since the list of objects of civil rights includes the term other property. As Belov notes: «that is, alongside some other property. It seems that this notion extents no further than its only element energy»[3].

In our opinion, energy, being a value and an economic benefit (Korneev), more precisely, a material good, is not a thing. It is still less possible

[1] V. V. Putin, Half a Century of European Integration and Russia [in Russian] http;//kremlin.ru/appears/2007/03/25/1121_type63382_120754.shtml

[2] V. A. Belov, Civil Law: Generals and Particulars: A Textbook (AO Tsentryurinfor, Moscow, 2003), p. 127 [in Russian].

[3] Ibid.

to treat it as a right. Nevertheless, and this is obvious, it is an object of civil rights. Energy is an independent phenomenon (element) of the material world and an independent object of civil (and not only civil) rights, not identical to property (thing). Owing to the energy conservation law, the notion of energy links all natural phenomena.

Theoretically, energy can be obtained from any substance, but it is produced from specific sources (energy carriers), whose use requires certain legal regulation.

It is clear that there is no energy without a source. So, let us define at the legislative level the notion of energy sources and the legal framework (conditions) of their use.

I do not want to say that we do not have documents with all these definitions, but at the legal level, perhaps, except for the Russian Law On Gas Supply in the Russian Federation, in which art. 2 «The Main Notions» gives the notion of gas, other energy sources (energy carriers) have not been defined. One can argue with me that it is not the legislator's business to produce chemical, physical, and other definitions of energy carriers (oil, coal, gas, etc.). And I will easily agree to this. However, let me repeat that lawyers operate with clearly formulated notions. In this respect, the legal definitions of the notions of energy carriers must be legally clear. Which is, unfortunately, not the case today.

A vivid example of this may be a situation with the adoption and coming into effect of the Russian Federal Law of July 18, 2006, No. 117-FZ On Gas Export. What gas does this law cover? Paragraph 2 of art. 1 of this law says: «This Federal Law is adopted with regard to gas extracted from all types of deposits of hydrocarbon raw materials and transported in a gaseous and in liquefied state».

Such a broad (and generally correct but not fully specified) law definition has lead to the fact that many oil companies and other gas-export stakeholders have found themselves cut off the pipe. Because art. 3 of the said law says: «the exclusive right to export gas is granted to an organization that owns the united gas supply system or to its subsidiary company in whose charter capital the share of participation of the organization that owns the united gas supply system is one hundred percent».

To correct the situation, the Russian Federal Customs Service explained in its Teletype Message (what kind of a legal document is it?) of October 16, 2006, No. TF1962 that the provisions of the Federal Law On Gas Export are applicable to natural gas, transported in a gaseous and in liquefied state (codes TN VED 2711 11 000 0 and 2711 21 000 0). It is easy to notice that the Teletype Message, unlike the law, had the word natural added to the word gas and Russia's commodity classification codes for foreign economic activity (TN VED) stated.

On the other hand, we must stress that the adoption of the Federal Law On Gas Export bridged a gap in state regulation of the gas industry, because gas export relations had no special regulation before its adoption. Only one company, OAO Gazprom, exported natural gas from Russia.

Moreover, the law prevented competition in export markets between the exporters of Russian gas, creating a single export channel.

It seems advisable at the present stage of development of legal regulation of relations in the energy sphere (most probably, subsoil use) to define more precisely at the legislative level such notions as energy resources (energy carriers: oil, gas – already mentioned, coal, hydropower, nuclear power, alternative energy, renewable energy sources, etc.), energy services, and conditions of their use (provision).

In the long term, we must put under regulation everything that can and, most importantly, ought to be legally regulated. I realize that there are things that are not regulated by law and that law is not a universal regulator, but what objectively requires legal finalization must be finalized.

No laws can replace the culture of human relations. Nevertheless, if we want to establish a sound legal system, which would regulate relations in the energy sphere, and the energy sphere is two-thirds of environmental pollution, then we must, after adopting such normative acts, come in the long term to the development of a basic normative act, which would be called, for instance, the Energy Code. If anybody does not like it, we may call it the energy act, or the energy law, which, by the way, exists even in our former Soviet republics. Such a law would ensure a complex regulation of the energy relations under consideration and other closely related affairs.

We must remember that any system of scientific views (scientific theory), and all the more so the scientific-practical sphere, is built and maintained on its own categorical apparatus and instruments. The aforementioned notions, as well as a number of other notions, are the main categories of energy law.

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ENERGY EFFICIENCY DURING ENERGY EXPANSION

The search for Russia's national idea seems to have temporarily stopped, because this very idea is now being born during an experiment. The experiment consists of promoting Russia to the role of an energy superpower. Historically, the army, territory, and natural resources have always been Russia's main «arguments». The military power has already been used, showing both its opportunities and limitations. Territory, I am sure, will play its role again in the future, when environmental disasters, including global warming, will huge unsatisfied demand for new settlements and survival places. Natural resources, specifically, mineral deposits, are already playing the role of a key link in relation to constantly growing global energy hunger.

The main issue now is whether the policy of energy efficiency stimulation within a country is compatible with external energy expansion.

In terms of economic theory, it is difficult to give a definite answer to such a question, because external energy expansion encourages the growth of external prices for energy carriers. Domestic prices are gradually catching up with them, which makes local producers take radical measures to reduce energy consumption. Theoretically, superprofits gained from expansion are invested into long-term specials funds for future generations or are channeled into the development and implementation of alternative energy sources and into energy efficiency.

In Russia, the situation is more definite. So far, in terms of energy efficiency growth, the positive results of the policy of external energy expansion have not been visible.

Expansion generates a monopoly, Gazprom. Last year, the independent gas sector halved the gas production growth rate. The economic policy of Gazprom is mainly based on the foreign policy of the Russian Federation, since Gazprom provides the European Union with about 29% of its natural gas needs. The mission – the regular provision of consumers with 'cheap' fuel deliveries (meaning a stable predictable price and not a speculative one) – comes into conflict with political gains.

At the same time, the gas-supply situation in the Russian domestic market is becoming pretty tense. Russian power plants introduced gas limitations in winter. According to serious domestic researchers (Institute of Energy Policy), the basic natural gas deposits are being sharply depleted. Today they produce about 300 billion cubic meters per year, but forecasts for 2010 are only 200 billion.

The problem lies in the fact that Gazprom buys noncore assets, including oil companies, soccer clubs, and electric power facilities. An issue of constructing nuclear power plants worth of nearly $60 billion has been discussed lately.

Generally speaking, in a situation of Gazprom's total energy monopoly, price signals may stop operating. Many promising, or, say, already tested and proved energy-efficient technologies, as, for example, bioethanol production and utilization, may be shelved, because they are not among the monopolist's priorities. It turns that the author, against his will, was unable to avoid the classical Marxist analysis, and all his evaluations turned out applicable to contemporary Russia but not to developed countries.

In the history of Russia, foreign policy has usually influenced negatively the national economy. It is naive to reckon that foreign policy is all by itself and that domestic life will tune up by itself. Monopolies are detrimental. They can yield short-term political effects, but they are able to affect innovative development negatively. Under monopoly conditions and price imbalance, energy efficiency is left with too few degrees of freedom, although, no doubt, there will be certain achievements against all odds.

M.L. Kozel'tsev
Executive Director of the Russian Regional Environmental Center

CLEAN PRODUCTION AS A CONTRIBUTION TO SUSTAINABLE DEVELOPMENT

Contemporary economically developed countries understood in practice long ago that the resources of our common home – the earth – are far from being boundless. A civilized approach to the use of natural resources is based on one important concept: in order to make sustainable the economic development of a country, a region, or even an individual enterprise, it is necessary to clearly prioritize needs and adopt a strict program of limitations, so that, conventionally speaking, the current generation does not leave a desert after itself. Crisis-free sustainable development, so desirable for all countries without exception, is based on today's economic performance of a country, its technological level, and the improvement of social organization; however, all these factors must necessarily take into account the environment's ability to meet both immediate needs and – we must stress this – needs expected in the future. The basis for this balance is the competent saving of resources.

In Russia, for different reasons, such, for example, as failure to understand the necessity of financing nature conservation projects; the constant absence of funds for nature reclamation programs, whose solution is delayed indefinitely; and, which is most important, the impotence of environmental education, which forms the relevant mentality of society; there is practically no awareness of the necessity to implement the concept of sustainable development. The overwhelming majority of resource-saving programs represent «hole patching»; i.e. they are oriented toward short-term nature conservation projects and do not take into account important factors such as the real sources of financing, operating expenses, timely repayment of borrowed capital, etc. In fact, these projects contain only the description of needs and wishes. In the contemporary world, developed countries employ an environmental-economic approach, the core of which is in the systemic evaluation of the ability to achieve the expected results of resource saving in the conditions of actually set limitations, for instance, such as program execution period, financial resources, etc. In fact, this is the problem of optimizing production processes, where the target or limiting parameters, alongside other things, are environmental characteristics. A way out of the global and topical also for Russia deadlock is a large-scale introduction of the Clean Production Program into all economic activities.

The Clean Production Concept

This is an economically targeted program of real resource saving, capable of providing sustainable development for our country. The Clean Production Program takes into account the latest developments of economically developed countries. A school, based on this program, is to train engineers of different specialties in the art of planning and implementing scientific and technological projects in order to reduce the ultimate consumption of material and energy resources, as well as production and consumption wastes, under the real financial costs and the fulfillment of posed production targets. To this end, the Clean Production Program's main component is a package of methods for training

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engineers in the active financial planning and management of a modern enterprise with regard to the strategy and tactics of environmental control. In other words, this program teaches through case studies to solve the problems of system optimization where the target function is the minimization of energy and environmental costs under the sustainable development of an enterprise, an industry, or a region.

In Russia, the Clean Production Program has been implemented since 1994. As a result of long and tedious search and evaluation of various trends that exist in the world, we have chosen the Clean Production Program, developed by Norwegian engineers, as one that suits best the Russian conditions. The program's goal is to train the leading engineering and technical personnel of different industries in the methods of saving all types of resources, reducing hazardous emissions into the environment, and producing «cleaner» products. A certain euphemism of the last notion implies that it is impossible to obtain absolutely clean production under the current conditions; therefore, the program's real goal is the reduction of hazardous effects to a level where nature itself can cope with arising pollutions. The program's efficiency is such that each ruble invested into it yields two to five rubles of profits.

Within the framework of the training course, a group of engineers and technicians (25–30 people) is introduced to the methodology and principles of clean production. As a result, the trainees acquire the practical skills of conducting the systems analysis of technological chains with a view to identify the most economically efficient patterns of transferring their enterprise to the mode of the maximum economy of natural resources, reduced discharges and wastes, and the output of environmentally cleaner products. The trainees are also exposed to the market economy basics.

The training schedule is the following: three three-day sessions and the last two-day session (diploma), i.e. 11 days of full-time training. Intervals between the sessions are six-eight weeks, during which the trainees develop and execute clean production projects at their enterprises, where the Center's advisers and consultants visit them for methodological assistance in between the sessions. The use of this schedule ensures the best susceptibility of the trainees to the methods of practical implementation of specific projects.

After the training period is complete (total time is about six months), the trainees submit their diploma projects without attracting outward investments (Group A projects), which may be implemented during the training period, diploma projects with repayment periods of up to three years and investments amounting to €350,000 (Group B projects), and long-term diploma projects (Group C projects). The trainees who successfully defend their diploma projects receive international certificates, which give them the right to teach and conduct expert consultancy within the Clean Production Program in Russia and abroad.

During the training period and after it, the Center jointly with the leadership of enterprises analyzes the work of the trainees in order to select and submit Group B projects for investment. The maximum loan amount is €350,000; the repayment period is up to three years; and the annual interest rate is 6%.

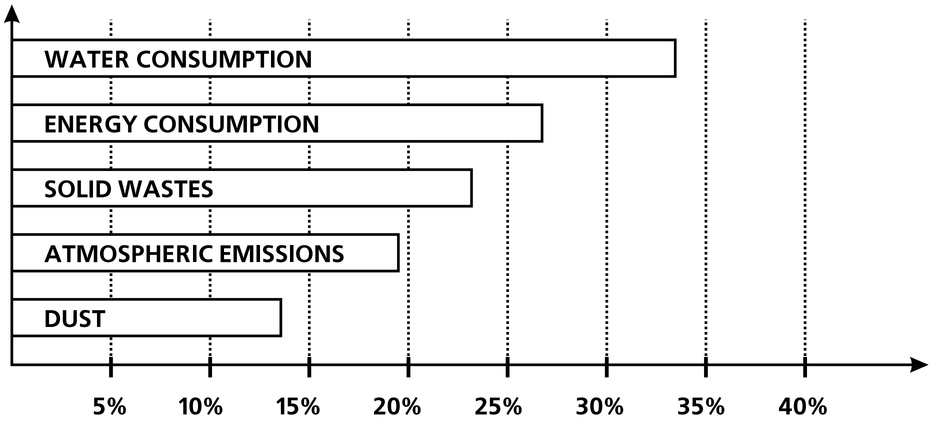
For the finalization of the business plans of the selected projects and their alignment with the investor, the trainees may take a course in financial engineering.

The investor is the Nordic Environment Finance Corporation (NEFCO), which uses the NEFCO credit line to finance nature conservation projects in the countries of Northern Europe.

For the introduction, coordination, and management of the Clean Production Program in Russia, it was decided to establish the Russian Center for Clean Production and Sustainable Development (Center). The Center was organized in 1994 by the environmental ministries of Russia and Norway within the framework of the intergovernmental agreement between Russia and Norway on environmental cooperation.

Initially, according to the agreement between the governments of Russia and Norway, the Center's field of operation was selected within the so-called Barents/Euroarctic region of Russia (the republics of Komi and Karelia, Archangelsk and Murmansk oblasts, and the Nenets Autonomous District), but in a few years, the success of the program became so obvious that its scope was extended to Novgorod, Lipetsk, Vologda, Kaliningrad, Leningrad, and Volgograd oblasts and the city of St. Petersburg. Four programs completed successfully in the transpolar affiliate of OAO Noril'sk Nickel. Noril'sk Nickel is a superprogressive enterprise in the field of nature conservation; it is conducting the fifth program now. The Center has developed good cooperation with the State Center for Nuclear Shipbuilding in Severodvinsk and the Solombal'sk, Segezh, Archangelsk, and other pulp-and-paper factories. The implementation of the clean production strategy is long, serious, and tense work, the success of which depends on the efforts of specific individuals who want changes for the better and sound support on behalf of enterprise leadership and administrative bodies. Today, the program is being introduced into such industries as pulp-and-paper, machine building, oil production, railroads, housing and utilities, and others. The program has extended far beyond its initially regional status: now it is operating in

Results of the Program implementation at 30 enterprises



Clean production as a contribution to sustainable development

oblasts and republics of Russia and in former Soviet republics. The number of specialists trained in the program has exceeded 1859.

Financing transfers to environmentally cleaner production (ECP) largely coincides with regular loan-type investments into production development, since enterprises have to gain profits in a relatively short period by saving all types of resources and reducing mandatory payments for emissions into the environment.

This is the way NEFCO operates. We must admit that, despite the profitability of NEFCO loans, Russian enterprises are not adequately insistent in receiving them.

At this stage, it is advisory, especially for enterprises in the European part of Russia, to increase the amount of loans. In addition, we must note that NEFCO prefers to interact with enterprises that are located in «hot spots», as, for example, the Nadvoitsk Aluminum Factory or the Archangelsk Pulp-and Paper Factory.

Another financer, interested in investments into clean production, is the European Bank for Reconstruction and Development with its special division for these purposes. Loan conditions do not differ greatly from regular industrial proposals; however, unlike NEFCO, the size of the loans starts at $5 million. Obviously, these loans suit better for complete transfer of an enterprise to ECP, which, in its turn, requires well developed and justified projects. This is quite possible, but the company management has not yet reached the understanding of such targets or is afraid of big risks.

The stimulation of transfer to ECP may take the form of setting up relevant funds on a parity basis with, for instance, NEFCO, a commercial bank, an enterprise, or a regional government. NEFCO forwarded such a proposal to Norilsk Nickel: for each party to allocate initially €1 million; however, this proposal has not yet interested the company. Attempts to establish a regional fund have not yielded a positive result so far, because banking structures avoid excessive risks and the legal situation for investments may change suddenly and unpredictably. There is no reason to hope for the creation of a federal fund, although this structure, with support from the Russian Ministry for Natural Resources and regional organizations could be very efficient in encouraging ECP transfers.

Of course, there are international financial formations such as the Global Environment Facility (GEF), which, theoretically, can loan something after long talks, but such efforts have not been undertaken so far. Thus, financial conditions, which largely determine the rate of transfer to ECP, change very slowly in Russia, and only their accelerated change may take production to sustainable development. On its part, the Center will continue developing proposals in this sphere, based on interaction with NEFCO and companies that operate in Northwestern Russia.

A.P. Tsygankov
Director General of the Center for Clean Production and Sustainable Development

RENEWABLE ENERGY IS THE BASIS FOR SUSTAINABLE DEVELOPMENT

Provision with energy resources is a key indicator of a country's energy security. Degree of import dependence is quite fully characterized by the self-sufficiency index (I_{ss}), which is a ratio of energy produced by a country to energy consumed by this country. If this index is less than one, the country is import dependent; if it is more than one, the country exports energy resources.

Among the G8 countries, the exporters of energy resources are Russia (I_{ss} = 1.6), Britain (1.2), and Canada (1.5). Other countries import energy resources, their energy self-sufficiency being pretty low: the United States (0.7), Denmark (0.5), Germany (0.4), Japan (0.2), and Italy (0.16). In this relation, it is interesting to know the dynamic share of different types of energy resources in the production of primary and electric power in the world over the last 30 years of the past century (1970s–2000s). Over the given period, the production of primary energy increased from 5.672 billion to 10.078 billion tons of oil equivalent, i.e., almost 1.8 times. In addition, the shares of different types changed as follows: the coal share decreased from 25.37 to 22.65%; that of oil and gas condensate decreased from 44.85 to 36.29%; that of natural gas increased from 15.96 to 20.76%; the total share of exhaustible fuel decreased from 86.18 to 79.69%; the share of nuclear energy increased from 5.1 to 6.71%; that of hydropower increased from 1.88 to 2.24%; the RES share over the 30 years remained practically unchanged at 11.48–11.36%, and, together with hydroelectric power plants, this share was 13.36% in 2000.

Sustainable development of the world community implies primarily the absence of energy crises. In its turn, the absence of energy crises is possible if all countries have access to energy resources. However, what is to be done if traditional energy resources have already been divided? Obviously, it is necessary to look for other opportunities. Such opportunities are renewable energy sources (RES) and primarily solar energy and its derivatives: wind energy, waterpower, and biomass. Renewable energy is in demand for two reasons:

- **depletion of organic fuel reserves and the dependence of the majority of developed countries on fuel import (mainly oil);**
- **significant negative impact of the traditional (fuel) power industry on the human habitat and wild nature.**

It is fair to say that the conversion of electric power adopted by the International Energy Agency (IEA) is incorrect. Thus, hydroelectric power is converted into primary energy by a theoretical coefficient (1 kWh = 122.9 g of conventional fuel in coal equivalent), and the coefficient of nuclear electric power is 3 times higher (1 kWh = 372 g of conventional fuel). In Russia, conversion into conventional fuel by the organic fuel replacement index is considered equal for hydro and nuclear power plants (340 t of c.f. per 1 kWh in 2005), which gives a real picture of their contribution to the electric balance of primary energy.

The share of hydro and nuclear power plants in the global production of electric energy are not distorted by conversion factors, and change in the share of energy resources is the following: the coal share has slightly decreased from 40.02 to 39.1%, that of oil has decreased significantly from 20.87 to 7.92%; that of natural gas has increased from 13.27 to 17.41; that of nuclear power has increased significantly from 2.12 to 16.86%; that of hydropower has decreased from 23.03 to 17.10%; and that of RES has increased from 0.69 to 1.71%. At the same time, the total production of electric power over the 30 years increased from 5247.5 to 15,379 TWh, i.e., 2.9 times. The growth rates of the RES share in the production of primary energy and electric power have increased significantly over the past 5 years of the 21st century. The apparent advantage of RES is their inexhaustibility and relative (to organic fuel) environmental friendliness.

Another global advantage of renewable energy can be expressed by the energy efficiency index. For each power plant or unit, we must compare energy produced over its lifetime to energy required for the production of its equipment and materials, for its construction, and transportation, as well as fuel consumed by the power plant. This ratio may be expressed through the index, which we call the energy efficiency index by analogy with economic efficiency. However, while the economic efficiency index (the payback period and all economic indices) depends on the price of all components of the project cost and electricity prices, the energy efficiency index does not depend on the market situation.

Thus,

$$K_{эн.эф.} = \frac{(Э_г - Э_{сн}) \cdot T_{сл}}{Э_{св} + Э_{тек} + Э_{топ}} \qquad (1)$$

where

$Э_г$ is the annual production of electric power by a unit (power plant); $Э_{сн}$ is plant service consumption; $T_{сл}$ is unit service life; $Э_{св}$ is energy spent on the production of equipment and materials; $Э_{тек}$ is energy required for unit transportation, assembly, and utilization; $Э_{топ}$ is energy confined in fuel.

This approach reveals the global advantage of renewable energy over fuel energy: since in formula (1) $Э_{топ} = 0$, there is a fundamental opportunity, proved more than once by calculations, to have $K_{эн.эф} > 1$. Then, like for heat and power plants, it is materially impossible to have $K_{эн.эф}$ more than the efficiency factor or the fuel utilization efficiency factor of this power plant; i.e., it is invariably less than one. Therefore, for condensation and nuclear power plants on thermal neutrons, $K_{эн.эф}$ < efficiency factor <1; for heat and power plants, $K_{эн.эф}$ < fuel utilization efficiency factor < 1.

An interesting conclusion is obtained for nuclear power plants on fast neutrons, since Этоп for them may equal zero or even take a negative value if the nuclear fuel production factor exceeds one. For such nuclear power plants, $K_{эн.эф}$ can be substantially more than one.

However, let us go back directly to renewable energy sources. If we look what the RES share is in primary energy production by continent and by country group at the 2004 level, we will see that it is 13% for the whole world, 49% for Africa, about 29% for Latin America, and about 32% for Asia. Of course, this share is determined mainly by the use of biomass (direct combustion).

In 2005, many countries of the world exceeded their RES share of 10% in primary energy production, including Australia (20.7%), Canada (16.4%), Denmark (14.7%), Finland (22.6%), Iceland (74.1%), Mexico (9.9%), New Zealand (29.1%), Norway (43.2%), Portugal (12.7%), Sweden (27.0%), Switzerland (14.9%), and Turkey (11.8%). In 2005, among the OECD countries whose RES share in electric power production, including hydropower, exceeded 10% were Austria (63.4%), Canada (60.3%), Denmark (24.8%), Finland (32.8%), France (9.8%), Germany (10.1%), Greece (10.0%), Iceland (100%), Italy (15.2%), Mexico (16.0%), New Zealand 65.4%), Norway (95.5%), Portugal (17.9%), Slovakia (15.4%), Spain (17.0%), Sweden (50.9%), Switzerland (55.8%), and Turkey (24.6%). For information: Britain (3.8%) and the United States (8.4%). An indicator of the use of «new» RES types (wind, solar, etc.) is the RES share in electricity production without hydroelectric power plants. In 2005 it was 4.6% in Austria, 24.2% in Denmark (mainly wind energy and biomass), 12.3% in Finland, 5.8% in Germany, 17.2% in Iceland, 5.2% in the Netherlands, 8.7% in New Zealand, 5.5% in Portugal, 7.9% in Spain (mainly wind energy), 5.3% in Sweden, 2.3% in Britain, and 2.1% in the United States. The European Union plans to reach 20% of RES in primary energy production by 2020.

Now, when the sustainable development of the global economy depends on provision with energy resources, analysts across the world make forecasts for the period 2030–2050. In 2006, IEA published Energy Technology Perspectives (Scenarios and Strategies to 2050), which contained six scenarios of accelerated development of the world's electric power technologies until 2050, which differed in the shares of exhaustible and renewable energy resources, and the basic scenario (if the present development continues). Note that, according to different scenarios, the 2050 RES share, including hydropower, will be 23–35%. Specialists in renewable energy sources, primarily wind energy, as well as the author of these lines, doubt these scenarios.

The European Renewable Energy Council has devised a forecast for the development of renewable energy sources until 2040, according to which the RES share, including large hydropower plants, in global primary energy production will be 16.6%, or 1.773 billion tons of oil equivalent, in 2010; 23.6%, or 2.690 billion tons of oil equivalent, in 2020; 34.7%, or 4.338 billion tons of oil equivalent, in 2030; and 6.678 billion tons of oil equivalent in 2040. We can see from this forecast that the 35% share of renewable energy sources will be reached in 2030 and not in 2050, as the IEA specialists think. What speaks in favor of this forecast? First of all, the growth rates of power, which the forecast assumed.

By decade, power growth rates to the previous year are 2–3.3% for biomass, 1–2% for large hydropower plants, 6–8% for small hydropower plants; 4–8% for geothermal power plants; and 10–16% for solar heat units. For wind units and photoelectric units, power growth rates until 2020 are adopted at 20–30% and 25–30%, respectively. The actual growth rates in 2000–2006 exceeded even these high rates. Thus, for photo electricity, they are 35–50%, and for wind energy, the average annual rates are 53% compared to 2000.

There is the ambitious wind energy program «Wind Force 10», which envisages that the share of wind energy will reach 10% of the global electricity production by 2020. Note that this forecast is being successfully overfulfilled. For example, in 2006, the total installed capacity of wind units should be 66929 MW by the forecast, and it has actually reached 74282 MW. Wind energy has become a substantial part of the energy industry of many countries. The leaders in installed wind energy capacity by the end of 2006 are Germany (20622 MW), Spain (11615 MW), the United States (11603 MW), India (6270 MW), and Denmark (3136 MW).

In 2006, already 13 countries had more than 1000 MW of installed wind energy capacity. In addition to the above countries, there are Italy (2123 MW), China (2064 MW), Britain (1923 MW), Portugal (1716 MW), France (1567 MW), the Netherlands (1560 MW), Canada (1459 MW), and Japan (1394 MW). In 2006, the annual commissioning of wind energy units reached a substantial figure of more than 15 GW. After a temporary recession in the development of wind energy in 2000–2004, the United States is again taking the lead in the wind energy industry.

There are many statements concerning the low installed capacity utilization factor of wind energy units. Here are data that give an exhaustible answer to this question: the world's average RES installed capacity utilization factor is 23%, which is just 2.2 times lower than the average installed capality utilization factor, of Russia's electric power plants (50%), but higher than the Киум of Russia's diesel-driven power plants (18%). Therefore, wind energy has become a real subindustry of the electric energy industry, and we have all reasons to expect its share in electric power production to reach 10% by 2020.

The role of photo energy is very humble in the total energy industry; however, it is beginning to win leadership in the power supply of self-contained consumers. Under the average efficiency of solar batteries of 13–15%, the rate of increasing the production of photoelectric cells and modules (the most expensive equipment) over the past six years has exceeded all forecasts, reaching 40–50% against the previous year. Special confidence in the development of the photo energy industry is given by the fact that the largest manufacturers of photo electric cells and modules include representatives of petroleum giants: BP Solar (2nd–3rd place in the world) and Shell Solar (4th–6th place in the world), which also develop successfully the wind energy industry.

Finally, one of the largest issues is the so-called RES «expensiveness». This is probably the strongest myth, which contradicts outrightly the data in the table. As we see, the process of equalizing the specific capital investments and production cost of electricity between traditional and renewable energy at the 2005 level may be considered finished. The outlook until 2030 shows that further reduction of the above indicators for renewable energy and their increase (appreciation) for traditional energy are quite possible.

What is the situation in Russia like? As is known, with 2.4% of the world's population, Russia has 12% of the world's oil resources, 35% of the world's natural gas resources, 16% of the world's coal resources, and 14% of uranium. This creates an illusion that Russia does not need to deal with the use of renewable energy sources. However, back in 1992–1993, Russia determined the zones (fields) of economic, environmental, and social efficiency in the use of renewable energy sources. Further events have proved more than once the correctness of these conclusions. The state-of-the-art renewable energy sources may greatly contribute to the solution of the following urgent problems.

Sustainable heat and power supply, adopted for similar climatic conditions, to the population and industry in zones of decentralized energy supply, primarily regions of the Extreme North and equivalent territories.

Guaranteed minimum of energy supply to the population and industry (especially agriculture) in zones of unstable centralized energy supply (mainly in deficient energy systems) to prevent losses from emergency and restrictive blackouts, especially in rural regions and in the farm processing industry.

Reduction of hazardous discharges from power plants in certain cities and settlements with envi-

The existing and perspective RES cost guidelines according to the International Energy Agency (IEA)

	Capital investments, $ / kW		Production cost $ / kWh	
	2005	2030	2005	2030
Biomass	1000–2500	950–1900	3,2–10,3	3,0–9,6
Geothermal energy	1700–5700	1500–5000	3,3–9,7	3,0–8,7
Traditional hydropower	1500–5500	1500–5500	3,4–11,7	3,4–11,5
Small hydropower	2500	2200	5,6	5,2
Solar photo energy	3750–3850	1400–1500	17,8–54,2	7,0–32,5
Solar heat energy	2000–2300	1700–1900	10,5–23,0	8,7–19,0
Tidal energy	2900	2200	12,2	9,4
Land wind energy	900–1100	800–900	4,2–22,1	3,6–20,8
Marine wind energy	1500–2500	1500–1900	6,6–21,7	6,2–18,4
Nuclear power plants	1500–1800	–	3,0–5,0	–
Coal-driven heat and power plants	1000–1200	1000–1250	2,2–5,9	3,5–4,0
Natural gas-driven heat and power plants	450–600	400–500	3,0–3,5	3,5–4,5

ronmental problems, as well as in mass recreation areas. All source data for the solution of these problems in Russia are available. Namely: RES, equipment, and potential but, unfortunately, insolvent (in the majority of cases) demand.

Russia has RES of all types, and the majority of its federal constituents have two or more RES types. Krasnodar krai has unique renewable energy resources and the economic potential for them: geothermal and solar energy, wind energy, the hydropower of small rivers and streams, and the low-potential energy of the sea, ambient air, and industrial waste water sinks. The technical potential of renewable energy sources in the krai exceeds two orders of magnitude the current power consumption in the krai. It is not by chance that solar heat supply systems are widely used in this krai. If we take Russia as a whole, the economic potential of renewable energy sources is, according to the latest developments, about 320 million tons of conventional fuel, i.e., about 30% of the domestic consumption of energy resources in 2005 (970 million tons of conventional fuel).

There are designs and small-batch production of all types of equipment for renewable energy, except for wind units with capacities of 30 kW and higher. Material success has been reached in geothermal energy. The recently constructed Verkhne-Mutnovskaya (3 X 4 MW) and Mutnovskaya (2 X 25 MW) geothermal plants use equipment that was designed and manufactured at Russian enterprises (OAO Geoterm, the Kaluga Turbine Factory, etc.). Solar collectors manufactured by the Kovrov Mechanical Factory and micro and small hydropower plants manufactured by MNTO INSET have successfully been operated for more than ten years now, as well as photoelectric cells and modules delivered abroad by many Russian manufacturers.

However, the available opportunities are utilized only 5–10%. Barriers and obstacles are plenty.

One of the main barriers is the absence of any incentives to develop renewable energy sources and control this process at the government level. Nevertheless, enthusiasts keep the industry afloat and even develop it somehow. For example, at the 2005 level, the RES share in electric power production was 10 billion kWh, or about 1.0% of total power produced, and heat energy sales were 95 million Gcal, or 6.7% of total heat sold.

The outlook for RES development until 2020, made in 2000, turned out to be too pessimistic. It was assumed that by 2010 the RES share in electric power production, including small hydropower plants, would be 1.0%. This indicator was practically reached in 2005. RES-based heat energy production outstripped forecasts, reaching 95 million Gcal in 2005 against the 70 million Gcal forecast for 2010. This is a case when we are happy with prognostic errors. Nevertheless, we must note that the said growth was mainly due to increased direct wood and wood waste combustion, as well as to increased electric power production by more fully utilizing small heat plants driven by pulp-and-paper and wood wastes. Progress in the use of new renewable technologies is extremely small. The problem of incentives in the use of renewable energy sources remains very urgent.

According to the data of the Russian State Committee for Statistics (Goskomstat) over the 2000–2005 period, the RES share in electric power production, including small hydropower plants, was about 0.9%, or 8.4 billion kWh, and the RES share in heat production was 4.9%, or 69.3 million Gcal. Together with centralized deliveries of firewood, the RES share was 1.2% in primary energy production and 2.2% in domestic consumption.

The use of renewable energy sources in Russia, based on personal and team enthusiasm in 2005, has reached its maximum and will not continue. At the same time, global energy development, including participation in the G8, requires that Russia increase vigorously the RES share in its energy balance. For Russia not to lag hopelessly behind global energy development, it is necessary:

- to develop and adopt a federal law to stimulate RES equipment investors, developers, manufacturers, and users;
- to envisage annual funds in the federal budget for the construction of renewable energy facilities reaching at least 10% of the total government financing of the nuclear and traditional energy industries;
- to establish national targets in Russia's Energy Strategy until 2030 for the use of renewable energy sources or for commissioning RES capacities;
- to establish a federal executive body responsible for renewable energy development;
- to develop and approve a complex of regulatory documents that obligates and stimulates economic agents to use RES under certain natural and climatic conditions; and
- to develop and approve a complex of regulatory documents that stimulates and obligates organic-fuel manufacturers to use RES.

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RENEWABLE ENERGY SOURCES IN RUSSIA: THE POTENTIAL, GOALS, AND REALITY

In recent years, the world has experienced accelerated growth of prices for fossil fuel, primarily oil and natural gas, which have currently exceeded their historical maxima. The growing dependence of many countries, both industrially developed and developing, on the import of energy carriers and fossil fuel tells negatively on their economic and energy security. The world is also getting more concerned with growing CO_2 discharges, which have increased more than 20% over the past decade. They are largely predetermined by the global energy consumption growth, chiefly, by the combustion of hydrocarbon fossil fuel and its products.
It is possible to overcome these unfavorable tendencies only by changing energy and climate policies, introducing new efficient technologies, and expanding the use of renewable energy sources (RES), which may partially replace fossil fuel.

Russia has great reserves of practically all types of renewable energy sources. In addition, almost all regions of the country have at least one of them whose commercial utilization can be justified. The scale and structure of Russia's RES potential are given in Table 1.

By the evaluation given in the Energy Strategy, the technical RES potential is about 4.6 billion tons of conventional fuel a year. This means that it is five times higher than Russia's consumption of all fuel and energy resources. The economic potential is defined at 270 million tons of conventional fuel a year, which is slightly more than 25% of Russia's annual energy consumption. Note that the given evaluations were made in the mid-1990s (no evaluations were made later) and should be updated with regard to changes over the past ten plus years. The update will most likely increase the above values.

For comparison, let us present newer interval evaluations of the economic potential of Russia's renewable energy resources, obtained by RAO UES of Russia (Table 2).

In particular, the amount of biomass suitable for energy production includes up to 800 million tons of wood, 250 million tons of agricultural wastes, more than 70 million tons of wood wastes, more than 60 million tons of solid household wastes, and up to 10 million tons of animal wastes. Out of these resources, it would be possible to produce about 100 million conventional fuel tons (CFT) of biogas (120 billion m^3) and 30–40 million CFT of methanol. In addition, economic growth, which is observable in recent years and which is, according to forecasts, to continue with rate variations, and the improved liv-

Table 1. The potential of renewable energy sources in Russia, million CFT/yr

Resources	Gross potential	Technical potential	Economic potential
Solar energy	2 300 000	2300	12,5
Wind energy	26 000	2000	10
Small hydropower	360	125	65
Geothermal energy	n/a	n/a	115
Bioenergy	10 000	53	35
Low-potential heat	525	105	31,5
Total	2 340 000	4 593	273,5

Source: IEA.

Table 2. The economic potential of Russia's renewable energy resources, million CFT/yr

Small hydropower	65–70
Tidal energy	35–80
Geothermal energy	115–150
Solar energy	12–13
Wind energy	13–15
Low-potential heat	30–35
Total	305–415

ing standards will entail further growth in the formation and accumulation of all of the above resources.

Russia is also capable of producing biodiesel fuel from rapeseed of varieties customized for Russian climatic and soil conditions.

By involving RES into the energy balance, Russia would be able to save significant amounts of non-renewable fossil hydrocarbon fuel resources. The biomass of the European part of Russia alone may generate energy equivalent to 400 TWh of electric power. The potentialities of such saving are demonstrated by the data in Table 3.

Moreover, increased RES use could improve living conditions, reduce unemployment in depressed cities, settlements, and villages, and, consequently, decrease the outflow of people from rural areas and remote Northern and Far Eastern regions.

At present, Russia utilizes an extremely small part of the RES reserves. In 2000, their share in gross energy deliveries was 3.5%, two-thirds of this volume falling on hydropower generation. At the same time, RES could successfully replace diesel and other petroleum fuel units in numerous remote settlements in many Russian regions, which are not linked to the United Energy Supply System and are constantly experiencing problems due to fuel supply shortages. About ten million people live in such regions, located mainly in remote northern parts of the country with severe climate. Another large and socially important market for small nonnetworked RES-driven units are small villages, dacha settlements, and separate homesteads and dachas, owned and used by a large part of the country's population.

The scale of utilization is primarily affected by the fact that, although the RES potential is much higher than the potential of traditional energy sources, the cost of equipment, construction, and assemblage at nontraditional energy sites is still high enough compared to traditional energy generation.

As for the state of the art of Russian RES technologies, they are comparable to the world level by their operational and technical characteristics, except for wind energy units. As for the cost of domestic equipment, it is usually 1.5–2 times cheaper than the imported. In particular, wind energy units below 30 kW are 3 times cheaper than the imported ones, while higher-capacity units have practically no price difference. However, practically none of the developed technologies has yet been taken to the level of commercial equipment ready for mass deliveries to the market, stalling at demo models at best.

As an example of state-of-the-art RES developments, we can name the Kovrov Mechanical Factory, which long ago designed and manufactured a pilot batch of air-type solar collectors. Two such collectors were tested by the Rostovteploelectroproekt Institute in Taganrog back in the summer of 1999.

At present, the operation of solar collectors in Russia does not exceed 100,000 m^2, while in Ger-

Table 3. The specific annual saving of organic fuel due to the use of renewable energy sources in Russia

Renewable resource	Resource measurement unit	Saving, CFT/yr
Geothermal well	pc.	10–40
Solar collector	m^2	0,12–0,15
Solar photo battery	m^2	0,8–1,2
Wind energy unit	kWh	1–2
Bioreactor	m^3	0,8–1,2

many it is ten times higher. The actual output of solar collectors in Russia does not exceed 2000 m^2/yr.

In Russia, the firm Rand has developed the world's only micro hydropower plant with a submersible generator. Such a hydro unit can be used at seasonal work by fishermen, hunters, and geologists in remote regions, i.e. where no stationary or self-contained (diesel generators) power supply is available but where a network of rivers is present.

In Russia extensive research has been conducted to create calculation and test methods and to set up the serial production of certain wind energy units. At present more than 3000 such units have been produced and are being operated.

For the developers to have chances and incentives to continue their work toward mass market products, substantial target government support is needed. In addition, note that, the rollout of wind energy units to the market needs additional huge expenditures on transportation, construction, assemblage, and other activities.

Russia's Energy Strategy until 2020 envisages the following measures as strategic goals in the development and use of renewable energy sources and local fuels:

- reduction of the consumption of nonrenewable fuel and energy resources;
- reduction of the load of the fuel and energy complex on the environment;
- provision for decentralized consumers and regions with remote and seasonal fuel deliveries; and
- reduction of expenditures on long-range fuel.

According to the estimates of the Institute of High Current Electronics, RAS Siberian Division, electric power generation by wind units, including small hydropower plants, may reach 24 billion kWh by 2020 in Russia.

Among the obstacles in the way of the RES market development in Russia, the International Energy Agency (IEA) pointed out in 2004 the absence of a real government policy and transparent energy markets; subsidized gas fuel prices; weak financial institutions; various budgetary subsidies to finance fuel and energy purchases; and huge explored reserves of fossil fuel (coal, natural gas, oil), which create an illusion of complete and total energy security. The absence of an efficient target government strategy of support for RES development and application and the lack of the necessary legal and regulatory framework also create barriers for RES promotion in Russia. A Russian way to encourage the RES market development, tested by many countries, could be:

(1) The adoption of a national RES strategy, setting goals and objectives in the RES sphere.

(2) The adoption of a legal package to encourage the formation of a market structure.

(3) The adoption of a target RES program.

Russia's Energy Strategy until 2020 stressed the necessity to adopt a federal law on RES, which would determine the roles, responsibility, and authorities of individual government bodies in implementing the RES strategy. The target RES program would help regional and local authorities to support directly specific projects for the introduction of RES-based technologies.

However, in reality, no progress is observable in creating conditions for RES development. The legal and regulatory framework and economic incentives have not yet been developed, and the target RES program has come to a stand still.

As a result, according to the energy development forecast in Russia's Energy Strategy until 2020, the RES share in energy generation in Russia will decrease. This trend sharply contrasts the prognostic evaluations of the future balance of the main energy types in the EU countries, given in the same figure.

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ECONOMIC ASPECTS OF FORMING A RENEWABLE ENERGY SOURCES SUPPORT SYSTEM IN RUSSIA

Analysis of factors that influence the efficiency and economics of energy production based on renewable energy sources is important, primarily, in terms of the «right» adjustment of a system of measures to support renewable energy sources (RES).

The total number of countries that have adopted this or that system to support the development of renewable energy is 48 today, including 14 that belong to developing countries by the UN criteria. Overall, we know four different patterns of support for RES development.

- The adoption of fixed tariffs for RES energy or fixed market-price increments for such energy (Austria, Denmark, France, Germany, the Netherlands, Greece, Spain, India, Brazil, the Czech Republic, Italy, Canada, etc., 41 countries overall).
- A system of mandatory quotas for the production or consumption of RES energy (Britain (since 2002), Italy (since 2001), Sweden (since 2003), Belgium (since 2002), Japan (since 2003), the Netherlands (1997–2000, then a tariff pattern), and the United States (only some of its states)).
- A tender pattern for the implementation of RES-based generation projects (Ireland, France).
- A system of special tax credits, i.e. a procedure of amortizing the investment costs of RES projects at the expense of other projects (the United States).

We are going to consider only the first and second patterns, since France has actually suspended the tender system (tenders have been postponed several times, and there is still no new announcement). Ireland has not used it for several years owing to liability problems in case of delays or refusals to implement tendered projects. In 2006, the Irish government announced that it would take the German pattern (fixed tariffs) as the basis for its new legislation. Tax credits, used in the United States, do not fit into the Russian tax system.

Out of the first two systems, the older one is the use of fixed tariffs; it was first adopted in the United States (at the state level) in 1978. By 1997, the number of countries that employed this system reached 9, and by mid-2006, 41. In some countries, this pattern was transformed into a pattern of fixed market-price increments (Denmark, Slovenia, and Slovakia) or was complemented by this option (Spain).

The system of quoting RES energy consumption is much younger. The majority of countries introduced it in 2001–2003, when the EC adopted the European Directive 2001/77/EC on renewable energy sources and set high normative indicators for RES utilization in the EU countries by 2010.

This quoting system made it outwardly very easy to transform these normative indicators into consumption quotas. However, the practices of using this system are very ambiguous. The Netherlands used it from 1997 to 2000 and then switched to the tariff system in 2003. Experts[1] relate Japan's serious failures in the RES sphere in recent years main-

[1] www.eufores.org/uploads/media/Dr_Iida_Tetsunari_-_political_lessons_from_japan.pdf

ly to the underdeveloped quoting system. Sweden, having introduced the system in 2003, conducted its serious adaptation already in 2005.

In 2005–2006, a number of EU comparative research projects were conducted: the OPTRES/Green-Net Project, the joint investigation by MIT and Cambridge University[2] to analyze and evaluate the efficiency of different RES support patterns. The practices of using both systems allowed specialists to make general conclusions about their advantages and disadvantages.

This investigation included the comparison of the average RES energy price level in countries with different support patterns, as well as the level of the relative efficiency of such support in a country. The leaders in RES energy prices (in the price descending order) are Britain, Italy, Belgium-Flanders, and Belgium-Walloon, which use the quoting system. As for the relative efficiency level of the RES support system, the leaders (in the descending order) are Spain, Germany, Ireland, and Austria, which use the system of fixed tariffs or fixed price increments. In addition, the relative efficiency level of the last member in this group (Austria) exceeds 2.5 times the same index of the price-leader countries: Britain, Italy, and Belgium. The research conducted and RES support practices in different countries prove vividly the advantages of the pattern with fixed tariffs or fixed price increments.

Another important aspect of analyzing the economic factors of RES support system designs is the source of this support. The most widespread options in other countries are:

- the population through increased tariffs for RES energy consumed;
- industry-consumer through RES energy quotas (linked to the system of RES energy consumption quoting);
- the system operator through the commitment to purchase at a fixed tariff and to include the costs into its tariff for services (linked to the fixed tariff system);
- grid companies (in fact, distributors) through the commitment to purchase at a fixed tariff and to include the costs into their tariff for services (linked to the fixed tariff system); and
- market players through a special market fee (linked to the system of fixed market-price increments).

The choice of a source depends mainly on political choice, energy market structures, and, respectively, the international competition rules of the EU or WTO.

A brief analysis of this list shows the following. The population as a source is an option that is politically hard to overcome, although a poll, conducted for the second time by the Russian Public Opinion Research Center (VTsIOM) in 2006, on people's attitudes to the energy industry has shown that new and environmentally clean energy types (solar, wind, tidal, geothermal) remain the most attractive. Although, compared to September 2005, the level of their popularity in 2006 dropped from 49 to 37%; nevertheless, it can still be regarded the leader in public opinion with an unprecedentedly high level of breakaway from the rest of generation types[3].

The System Operator's involvement in a RES support pattern is possible through a mechanism of including these increased costs into his service tariff. However, we must clearly understand that the emergence of new financial flows, a new level of liability, new counteragents, and new processes in the System Operator will inevitably lead to the growth of its risks as an economic agent, which is hardly acceptable in terms of the System Operator's chief function: to provide the reliability, security, and equilibrium for the country's united energy system.

So, the possible and realistic source of funds for such support is either the whole electric power market or just its part, for example, either grid companies alone or industry alone.

We were unable to find a support system that uses the country's budget directly, because practically all countries that use different support systems are either WTO or EU members, and the EU agreement (article 87) strictly limits such subsidies. There are options of indirect budgetary support through taxes: Finland, the United States, the Netherlands, etc. Almost everywhere, they are used in parallel with the main support patterns, except Finland, where taxes are the only form of support.

Regardless of the choice of RES support patterns, one of the most important economic aspects of efficiency factor analysis is the basis for comparison of the costs of traditional and RES-based energy generation. On the basis of this comparison, we will be able to make a conclusion about the feasibility of support measures and their level proposed in the draft legislation.

Most often, we can hear that RES-based generation is economically unprofitable compared to traditional generation for reasons inherent in the RES technologies themselves. In addition, the basis for comparison is almost never discussed, i.e. the level

[2] http://www.eref-europe.org/htm/documents.html; or http://www.econ.cam.ac.uk/electricity/publications/wp/ep70.pdf; or http://www.wind-energie.de/en/topics/price-systems

[3] www.regions.ru, November 17, 2006.

of tariffs that exists in traditional energy generation. Yet, in such comparisons, this level predetermines the economic «fairness» of the tariff level for RES-based energy.

Under economic fairness in this case, we understand the degree of state-approved influence of markets on the formation of the cost level for this or that generation type. Owing to great differences in the itemized structure of the costs of different generation processes, comparison is usually made not by items but by the ultimate expression of total costs, the tariff.

If a tariff itself or a price as a whole or its separate components are not the object of government regulation, then such a tariff or price may be called the fair basis for comparison. At present, in Russia, in the overwhelming majority of cases, both tariffs and their components: either the cost side or the revenue side, are under government regulation and control. If the government conducts such a regulatory policy, it would be impossible to acknowledge such tariffs as the «fair» basis for comparison. If they (costs and tariffs) are fully or largely formed under the influence of market prices for these cost items, then such a cost level may be called economically fair and justified.

What is the extent of such government regulation of tariffs and separate costs of the existing energy companies? As far as we know, no such research has been conducted into Russia's energy generation. Within the framework of the UN Development Program (UNDP), such subsidy calculations have been conducted for the global economy, and they have shown that total annual subsidies for traditional energy generation are about $250 billion. Assessing the state of the global energy industry, experts hold that, from 1995 to 1998, total annual subsidies to fossil- and nuclear-fuel energy were $215 billion.[4]

Approximately at the same time, the European Commission conducted its own project to assess the impact of subsidies on tariff levels within the framework of the ExternE Project[5]. The project experts tried to evaluate the real cost of electricity production with included overheads caused by environmental pollution. According to their opinion, if the cost structure of coal and fuel-oil power plants had accounted for costs related to mitigating the negative environmental and human-health consequences of their technologies, then the cost of their energy would have doubled. A similar calculation for gas-driven power plants has shown a possible 30% increase in their tariffs. The research valued these costs by EU country in 2005 as a total of €85–€170 billion, or 1–2% of the EU GDP.[6] Note that these calculations disregarded overheads related to climate change impacts on human health and security, on agriculture and on the ecosystem. It is clear that such an expanded calculation could lead to even more impressive results of the comparison if a justified methodological basis were developed. According to the data,[7] the total amount of subsidies in 15 EU member countries in 2001 was €29 billion, of which only 19%, or €5.5 billion, fell on RES.

A RES support pattern, as an object of stimulation, may be constructed on two basic approaches:

- Stimulation of individual cost items of the project's investment cycle: capital cost reduction, operating cost reduction, borrowed capital cost reduction, etc.; and
- Stimulation by the end product of RES-based generation – electric power – after the project's investment cycle is complete.

We divided all known factors that influence the level and structure of the RES-based energy production cost into two groups: economic factors (internal and external) and noneconomic factors.

Some external factors could be evaluated quantitatively, but this is a separate complex task. Even more difficult, we see the task of quantitative evaluation of the influence of these factors on the production cost of RES-based electric power. In addition, the majority of these factors can be eliminated or their influence reduced not so much by economic measures as by organizational and administrative measures. Apart stand factors whose influence could hardly be neutralized in the foreseeable future (for example, the social importance of energy prices for private households, the reduction of the potential of ultimate hydrocarbon fuel resources, and an upward price trend for the medium term).

Analysis of internal economic factors has demonstrated vividly that the indicators of all the main internal factors (elements) of the RES-based energy cost have a very wide spread. This spread is characteristic of both one RES type and of different RES types compared between themselves.

The values of indicators by RES type differ by times and sometimes even by an order of magnitude. For example, operating costs have a spread from 2.0 to 42.6%; the maintenance of borrowings fluctuates from 5.2 to 82% for the cost of 1 kWh, etc. The share of depreciation in the cost of 1 kWh is minimum 9.4% (tidal power plants) and maxi-

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[4] Global Wind Energy Perspectives. GWEC, Greenpeace, September 2006, p. 54.

[5] http://externe.jrc.es/overview.html

[6] Global Wind Energy Perspectives. GWEC, Greenpeace, September 2006, p. 55.

7 Renewable Energy Road Map. Renewable Energies in the 21st Century: Building a More Sustainable Future. SEC (2006) 1719/2, p. 11.

mum 75.2% (small hydropower plants). The ratio of equipment purchase costs to other investment expenses also differs greatly for various RES types.

As applied to RES support systems, this means that, in principle, support for individual factors of the energy production cost is possible. However, such a form of support would look like a multilevel, fractional, and large-scale system of measures if you want to take account of not only structural characteristics but also structural costs under different construction and operating conditions of power plants that use the same RES type.

For example, in the draft law, we specify 21 varieties of RES-based generators with regard to their specific features. Therefore, even if we preserve this number of varieties, it will multiple by the number of times equal to the number of separate cost items that you want to include into your RES support system. Then, if such cost items are three, you will have 63 varieties, and, if cost items are five, you will have 105 different values of RES support measures by cost item.

The second possible approach to the stimulation of RES-based electric power generation implies the reduction of such bases for support to only one element – energy produced and sold in the market. Here, the energy price of each generator will preserve the cost structure inherent in this particular generation type, but revenue distribution according to this cost structure already becomes the job of the owner of the generation unit.

Stimulation based on the second approach makes it possible to solve several problems at once.

First, the incentive system becomes simple and linked to one indicator, common for all RES-based generators.

Second, the system would get rid of the complex and fractional evidence basis to support justification by volume and by cost type and, simultaneously, of the danger of corruption during such justification.

Third, such a system would always stimulate the end result, actually obtained and acknowledged. This would help avoid a situation where support has been rendered but energy production has not started.

Proceeding from the characteristic features of the Russian electricity/energy market and limitations imposed on organizations in the industry by the Federal Law On Electric Power Industry, we included in the draft law on RES support an option for a special fee charged on market players as a source of fixed price increments. The use of the federal budget in Russia for fundraising needs the establishment of a target budgetary fund as an instrument of fund raising and redistribution. If we use the available set of budgetary support instruments and the established budgeting procedures, then it would be extremely difficult to create an efficient support system, mainly, for two reasons:

- The budget does not allow us to create a self-reproducing and reiterative system of fund raising and redistribution for a long (15–20 years) period.
- Budgetary support instruments are aimed toward separate items in the cost structure of energy production. For RES, this structure differs greatly from RES type to RES type. Therefore, these support measures would be important for some RES types (where the value of this cost item is great) and insignificant for others (where the share of this cost item is small).

The system of support for RES generators based on the stimulation of electric power production and sales is widely used in the world and exists practically in two main forms.

The first form implies the establishment of special purchase tariffs for such energy and a commitment imposed by the state on various entities to buy RES energy at such tariffs. These entities may be grid companies, distributors, or wholesalers, consumers, or just their individual groups. This pattern operates in many countries of the world. In this case, RES-based generators, in fact, leave the market and sell energy at fixed state-imposed prices or tariffs. If the share of such generators in total energy consumed is small, it will be unnoticeable. Yet, with the growth of the RES share in the country's total energy balance, distortions may occur in the market.

The second support pattern implies the establishment of fixed payments to RES generators in addition to their market revenues depending on the amount of energy sales and a RES type used for generation. In this case, purchase commitments are imposed on no one (no need for them, since all buy energy at market prices), and all generators operate on a market basis.

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THE ADVISABILITY AND EFFICIENCY OF DEVELOPING AND IMPLEMENTING THE NATIONAL PROGRAM «MASS ETHANOL PRODUCTION AND CONSUMPTION IN RUSSIA»

Russia has exclusive opportunities to easily excel Saudi Arabia in oil exports and almost double the expiration time of its proved oil resources. A means of achieving these goals is the development and implementation of a program of ethanol mass production and consumption in the country. In 2006, Brazil, which is close to Russia by economic indicators, became the world's first large country that is fully self-consistent in energy resources and that has fully stopped its oil imports. This is due to the successful implementation of the «Brazilian national ethanol program». Brazil's successes are so impressive that the United States, Japan, Sweden, South Korea, and Kazakhstan are starting the implementation of similar programs. In today's Brazil, ethanol ensures 40% of fuel consumed by automobile transport. A 20% ethanol addition to gasoline is mandatory in Brazil. Moreover, a network of 100%-ethanol filling stations is widespread there. Brazil has banned the production of automobiles that cannot be filled with ethanol. Out of the total fleet of Brazilian automobiles, 70% can be filled with either ethanol or gasoline. The country is implementing a large-scale program of economic stimulation for the production and utilization of ethanol and ethanol-driven automobiles. The country has banned the import of automobiles that do not run simultaneously on gasoline and ethanol. Ethanol production has reached a scale that Brazil exports it to Venezuela, Japan, India, Sweden, and South Korea. Brazilian ethanol export is 53% of world ethanol export (half a billion of gallons of ethanol a year is delivered to 12 countries), then comes Europe with 12%. By Brazil's example, the United States has announced that gas filling stations have a right and in some states are obliged (as, for instance in Minnesota) to add 10% of ethanol to gasoline. In 2006, Brazil decided to invest $9 billion into doubling ethanol production by 2010. Ethanol export incomes have already exceeded coffee export revenues.

State-of-the-art technologies make it possible to efficiently produce ethanol not only from sugar cane and sugar beets or corn, as the practice has been for many years, but also from any agricultural wastes, rush, wood processing wastes, cake, industrial cellulose wastes, any grass, and, essentially, from municipal household garbage. Taking into account the geographical size of Russia, the establishment of small ethanol plants would deliver the state of the need to provide rural homes and farms with energy. People would easily take their crops to the cities. The use of town garbage as a raw material for ethanol production would solve the problem of many urban and municipal bodies related to waste utilization. The use of ethanol extends the life of an automobile, sharply reduces air pollution, and makes it possible to produce ethanol by utilizing not only exhaust fumes but also the wastes of boiler units and heat and power plants.

In order to implement this program in Russia, the following activities are necessary:

- the establishment of small ethanol plants;
- the establishment of large ethanol-producing facilities, including many hydrolysis factories that are idle now;

Russia is the world's absolute leader in petroleum production. However, it is second in petroleum exports, slightly lagging behind Saudi Arabia. This is due to the fact that Russia is the world's fourth country (after the United States, China, and Japan) in petroleum consumption, although, in terms of GDP production, Russia occupies only the 10th–13th place in the world (depending on the calculation method). The energy intensity of Russian industry is the highest in the world, and, by this indicator, Russia easily gives way to any of the first 20 most economically powerful countries of the world. Russia's proved petroleum reserves are considerably smaller than Saudi Arabia's, where the state-proved reserves will expire in 115 years.

- to oblige legislatively Russian manufacturers to produce automobiles only with engines that can be fuelled by both gasoline and ethanol (appreciation is no more than $200 per automobile);
- to make a mandatory 5%-ethanol addition to gasoline at the gas filling stations in the North, Siberia, and the Far East and a mandatory 10%-ethanol addition in the country's southern and western regions (this level of ethanol addition does not practically influence automobile efficiency, although in Brazil today 25% of automobiles are fuelled with 100% ethanol);
- to allow Russia to import only those automobiles that are both gasoline and ethanol driven. Today all the world's leading automobile makers manufacture such automobiles. Such are the majority of models of Ford, Volkswagen, Mercedes, General Motors, Fiat, and Toyota. Seven out of ten automobiles produced in the world, as well as 20% of airplanes, can be fuelled by both ethanol and gasoline. In 2004, «hybrid-filling» automobiles constituted 30% of the manufactured total; in 2006, more than 70%. Twelve percent of automobiles manufactured in the world are designed to operate only on ethanol;
- to reduce the taxation of the manufacture, purchase, and import of such automobiles; and
- to oblige all Russian petroleum companies to establish ethanol filling units at filling stations.

The implementation of this program in Russia would make it possible to create about half a million new jobs and to reduce sharply environmental pollution, and a decrease in domestic oil consumption by 30% owing to its replacement with ethanol would allow Russia to almost double the life of the proved petroleum natural resources. Ethanol production may become the basis for Russia's new national economic strategy.

The Bush administration has strongly committed itself to ensuring US energy independence. The United States has adopted and made effective several legislative acts that envisage the consistent replacement of gasoline with ethanol. However, the problem of efficient replacement of gasoline with ethanol in the United States lies in the fact that the Unites States produce ethanol mainly from corn, which is significantly less efficient. The states of Indiana, Minnesota, and Montana, each of which has already established more than 200 ethanol filling stations, are developing, just like Canada, the production of ethanol from timber. For example, a $35-million plant has been built recently with an installed capacity of 17,000 gal of ethanol a day. To produce this amount, the plant processes 25 t of wood waste and dead tress daily. The state of Indiana is building a plant to produce ethanol from potato processing waste. Near Ottawa, Canada, a plant is being built to produce ethanol from woodchips and straw.

Efficiency-wise, ethanol produced from wood and cellulose waste is only 10% inferior to gasoline, while ethanol produced from corn is 30% inferior. The state of Iowa started to produce ethanol from wild millet, rush, grass, and wood bark. During 2005–2006, the United States ensured the addition of ethanol to gasoline sold at 30% of the country's filling stations, which has considerably reduced, among other things, air pollution along motor ways, and ensured a reduction of the production cost of one gallon of ethanol from ¢60 to ¢20, i.e., three times. All these measures have led to the fact that in 2006, the United States somewhat outpaced Brazil (44% of global production) in ethanol production and consumption (4.3 billion gallons) and took the first place in the world (45% of global production). This is just a beginning of a huge program on which the United States plans to spend more than $20 billion. In 2005, China produced 1.5 billion gallons of ethanol; India, 700 million gallons; in Europe, the leader is France, which produced in 2005 300 million gallons of ethanol from sugar beets, wheat, and wheat-processing wastes, having outstripped Russia by more than one-third with regard to this indicator. Since 2002, the annual growth of ethanol production has been 6%. Such attention to ethanol production in the United States is related to several factors: petroleum and gasoline price growth, instability in the Middle East, stricter environmental requirements, and the improved technological efficiency of processing urban garbage and industrial wastes into ethanol.

In 2005, the ousting of gasoline (170 million barrels of oil) by ethanol saved $8.7 billion. We may say that the legislative acts and standards adopted by the United States have already yielded qualitative and quantitative changes in the country's ratio of ethanol to gasoline production. Until 2012, the United States plans to spend $70 billion on the construction of ethanol plants and ethanol delivery and distribution infrastructures, which will ensure the annual production of 9 billion gallons of ethanol. For Russia, ethanol production is more important than for the United States due to its significantly larger territory. The establishment of small ethanol plants to meet the needs of small cities, villages, and farms would lift off the state the problem of providing fuel for agricultural transport, which would lead to a sharp increase in agricultural crop and product deliveries to the cities and ultimate consumers. Moreover, problems of delivering cities of household garbage would be solved, the number of dead trees in the woods would be reduced, swamps would be dried, and grass and algae would be used to produce motor fuel.

The article is based on Academician E.P. Velikhov's proposals.

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BIOFUEL: THINKING OUTSIDE THE OIL PIPE

We all know that Russia lives on the «oil pipe». There is a good English expression: «Think outside the box». After several years of high oil prices, a new saying appeared in the United States: «Think outside the barrel». It is high time Russia started thinking outside the oil pipe.

The world is entering an epoch of bioeconomics, i.e., an economy based on biotechnologies, which uses renewable raw materials to produce energy and materials.

What are the advantages of bioeconomics?

Social:

- **development of rural regions;**
- **improvement of the social situation in cities where hydrolysis factories are located; and**
- **improvement of human health, ecology, and life quality.**

Economic:

- **reduced costs, more thorough control over product properties;**
- **emergence of new products and markets; and**
- **reduced trade dependence on energy resources.**

Environmental:

- **prevention of environmental pollution, reduced discharges of greenhouse gases and other hazardous substances;**
- **materials, chemicals, and fuel made from biomass; and**
- **reusable and reprocessable products.**

First, bioeconomics affects the social situation positively. By the estimates of Brazilian scientists, each million liters of produced bioethanol creates 38 direct jobs. Therefore, biofactories create jobs where they are needed, not «on the oil pipe» but in agricultural regions.

The primary stock for the majority of bioeconomic products are sugars (glucose), starch (grain, cane sugar), or cellulose (straw, sawdust). One of the most advanced biofactories is the DuPont plant, which produces 100.000 t of bioplastics from corn per year. This bioplastic material (branded as Sorona) excels nylon by its cost and consumer qualities.

The most crucial products of bioeconomics are, in particular, bioethanol and biodiesel. Bioethanol is a liquid fuel, which is produced from agricultural products that contain starch or sugar, for example, from corn, grains, or sugar beets. Unlike alcohol, from which alcoholic beverages are produced, fuel ethanol does not contain water and is produced through shortened distillation (two rectification columns instead of five); therefore, it contains methanol and fusel oils, which make it undrinkable. Biodiesel fuel is esters of vegetable oils or animal fats. They are obtained as a result of a chemical reaction of an oil or fat with methanol. The reaction products are monoesters, known as the methyl esters of fatty acids (biodiesel) and glycerol (used in soap production and in pharmacology). The most widespread feedstock for biodiesel production is rapeseed in Europe and soybeans in the United States and South America. Rapeseed structures and improves soil very well and is an excellent crop for rotation with wheat.

Bioethanol and biodiesel are the only renewable liquid fuels that can be used as automobile fuel additives without changes in the motor design.

How is the world getting off the «oil curse”? How is the world moving toward bioeconomics? The active use of renewable energy sources from agricultural feedstock is observable in the United States, Japan, Brazil, China, India, Canada, and the EU countries. This direction is acknowledged as a priority in the national policies of these countries. Many countries (even «oil and gas exporters») have established special executive bodies that control and coordinate the implementation of alternative power production programs. The United States, for example, has adopted the farm bill, which states that the establishment of biofactories is a national objective. For market development, US government bodies, primarily the army and prisons, are to use biofuel. Scientific developments in the field of biodiesel, bioethanol, and biomass energy are supported by substantial grants. Support is rendered to large-scale research into processing biomass into bioethanol in partnership between the government and the private sector. Large amounts of money are allocated for the construction of pilot plants to produce biofuel. In 2007, the US senators from Iowa, Indiana, Delaware, South Dakota, and Illinois introduced the Biofuel Security Act, which envisages:

- the production of 190 million tons of bioethanol and biodiesel by 2030 (100 million tons by 2020);
- the promotion of filling stations with E-85 columns by mandatorily increasing their number by 5% a year to a level where 50% of all fill-

ing stations will be able to sell the E-85 fuel (85% ethanol);
- commitments of automobile manufacturers to increase in the production of automobiles that can use any ethanol/gasoline mixture (FFV) by 10% a year until reaching 100% manufacture of such automobiles (now, 2%).

According to the International Energy Association's (IEA) forecasts, the world production of biofuel will increase from 40 million tons of oil energy equivalent in 2006 to 150 million tons in 2030; annual production growth rates will be 7–9%. As a result, the share of biofuel in the total amount of fuel in transportation will reach 4–6% in 2030. In addition, the ethanol production rate will be the highest, because the cost of its production is expected to prop faster than the cost of biodiesel production.

Europe has adopted a program for the obligatory 10% content of biofuel in motor fuels. Explosive growth of biofuel production and consumption is observed with keen interest in this topic; substantial investments are channeled into biofuel projects. In Europe, the consumption of motor fuel made from renewable raw materials (bioethanol and biodiesel) will increase from 7 million to 15 million tons; in addition, investments into the construction of 40 new biodiesel plants and 60 bioethanol plants before 2010 will reach at least $4 billion. In Germany, 100% biodiesel is already sold at 2000 filling stations. Sweden has announced that in 15 years it will fully abandon oil in favor of bioenergy. Serious government programs are adopted to stimulate the development of the biofuel (mainly, bioethanol) market. For instance, each filling station that sells more than 4 million liters of gasoline per year is to have a E85 fuel column (containing 85% of bioethanol and 15% of gasoline). Bioethanol-fueled drivers may enter downtown Stockholm free of charge and do not have to pay for parking; annual automobile taxes have been reduced.

A bioethanol fuel plant, the first in the CIS countries, has been commissioned in Kazakhstan in September 2006; a few more plants are under construction. The government of the Republic of Kazakhstan is developing a national bioethanol/biodiesel program. The Ukrainian Rada (parliament) has adopted and the Ukrainian president has signed a law that stimulates the production of motor gasolines with bioethanol additives (reformulated benzenes); in addition, the excise tax for such fuels has been reduced from €60 to €30 per ton. A zero excise rate has been established for fuel bioethanol produced by Ukrainian plants. The Supreme Rada intends to bind the executive authorities of cities with populations more than 500.000 with an obligation to transfer the means of transportation to biofuel before 2010, the biofuel share reaching 10% by 2011.

Nobody is that naïve as to announce full replacement of petroleum fuel with biofuel. The existing fuel superstructure is very efficient and holds tightly its position.

Therefore, according to Volkswagen's estimates, nearly half of fuel used in the world will be gasoline and diesel fuel with very low sulfur content by 2030. A large share will fall on liquefied gas and gas-based liquid fuel. The share of biofuel will reach 15–20%.

Many scientists speak about hydrogen as the near future. Yes, hydrogen is an interesting and promising fuel, but, at the same time, the problems of its production, distribution, and utilization make impossible the use of hydrogen as a commercially affordable fuel over the next 30 years. In addition, we must understand that hydrogen is not a fuel but an energy accumulator. In order to obtain hydrogen, we must burn something somewhere: uranium at a nuclear power plant, coal at a regular power plant, or utilize the energy of hydroelectric power plants. Thus, hydrogen is an interesting prospect but not a solution to short- and medium-term problems.

Since straw, grass, and sawdust – inedible wood waste – serve as a raw material for cellulose ethanol, the production of bioethanol from them is not a threat to nutritional balance. Germany, the United States, and Brazil are already building pilot plants to produce bioethanol from cellulose, and, according to expert estimates, this technology will become commercially attractive in 5 years. The recently approved US law is an important step in this direction, for example, the government's commitment to buy 1 billion liters of cellulose bioethanol by 2013.

After the emergence of commercially attractive technologies of bioethanol production from biomass, special plantations of fast-growing plants (willow, poplar, sword grass) will play an important role, especially those located in Russia's warm zone. Siberia with its biomass resources will be an important but not the main source of raw materials for such factories, since the absence of roads and other infrastructure will substantially appreciate this resource, which seems to be «free» at first sight.

In Russia, the mixture of ethanol and gasoline is still taxed (excised) just like the mixture of ethanol and water (vodka), while all other countries do not excise this fuel. Thus, bioethanol is partially or fully tax exempt in seven countries (including France, Germany, Britain, Spain, and Sweden).

Bioethanol Ecology

Gasoline is the largest source of artificial carcinogens. Thanks to addition of just 10% of ethanol, gasoline is enriched with oxygen, which ensures fuller combustion and a reduction of carbon monoxide discharges by 30%. It also reduces toxic discharges by 30% and volatile organic discharges by more than 25%.

The mixture of gasoline and ethanol, known as E10, has been used by American motorists for a quarter of a century now. The use of E-10 is allowed by all major automobile manufacturers, and the use of E10 improves engine operation by adding 2–3 octane units to the antiknock quality of fuels, preventing engine overheating, functioning as fuel-system antifreeze, and causing no contamination of fuel injectors.

Biodiesel Ecology

The use of biodiesel fuels reduces the emission of practically all hazardous substances, compared to petroleum diesel fuels. In 100% biodiesel fuels, this reduction is 56% for unburned hydrocarbons, 55% for solid particles, and 43% for carbon oxides.

What fuels the biodiesel market in the United States and what will, probably, fuel this market in Russia? Laws have been adopted (also by Russia) to reduce sulfur content in diesel fuel from 500 ppm to 15 ppm (parts per million). Sulfur is known to be a good engine lubricant; low-sulfur diesel fuels require special additives to improve lubricity. Five percent of biodiesel in diesel fuel provide for the necessary lubricity, which normalizes fuel without special additives. The Russian agroindustrial complex alone consumes 5 million tons of diesel fuel annually. Under 5% consumption, 200.000 t of biodiesel are needed, and this means four powerful plants. In 2005, GOST R (Russian standard) 52368-2005 «Euro Diesel Fuel» was adopted, which allows up to 5% of biodiesel content. This GOST was developed by the All-Russia Research Institute for Petroleum Refining and the Lukoil Co.

A skeptic's question: will there be enough grain for bioethanol production? Russia exports 10–12 million tons of grain annually. In addition, a larger part of the exported grain is used as animal feed or for ethanol production in Europe. According to Russian Minister for Agriculture Gordeev, «today 20 million hectares of productive plow land are not used in Russia». Therefore, Russian agriculture can easily increase grain production by 20 million tons, which is enough to produce 7 million tons of bioethanol (Russia annually consumes 30 million tons of gasoline). ...What is Russia to do? We propose to stimulate the development of the bioethanol and biodiesel market in two stages: Stage 1: the development of biofuel production for export. Stage 2: the development of domestic biofuel consumption.

Medium-Term Outlook (until 2012)

Trends:

- rapid growth of the share of state-of-the-art machinery, which needs high-octane (over 92) fuels;
- legislative requirement of standards for fuel EURO–4 and higher;
- material deterioration of life quality in Moscow and other cities with a population of one million and above owing to unacceptable environmental conditions and the related health deterioration, outflow of the higher- and middle-class population to the suburbs, and increased consumption of fuel for daily trips;
- formation of a strong public opinion on biofuel as a reasonable and environmentally clean alternative to traditional fuels,
- increased mobility of the nation, especially of its economically active part, growth of average annual fuel consumption per family;
- natural gas and fuel price rises, approaching the European price level.

Consequences

- politicians project the public opinion on biofuel into actions, Laws On Biofuel and On Clean Air are adopted, which legislatively fix the mandatory use of biofuel (up to 5% of motor fuels consumed);
- acknowledgment of biofuel by oil companies as a necessity for the their existence in today's world;
- motor fuel consumption doubles, reaching 70–80 million tons;
- the beginning of the large-scale construction of bioethanol and biodiesel factories, 40 such factories with a total capacity of four million tons of biofuel to be built by 2012;
- in addition, direct investments of $2 billion, creation of 40.000 jobs during the construction of factories and 200.000 permanent jobs;
- grain price rise, income growth in agriculture; and
- increase in local tax revenues.

Time necessary to make the dream of using bioethanol and biodiesel on a grand scale a reality is determined not only by the size of investments or subsidies. Brazil required decades of development until the combination of high gasoline prices and the emergence of combined motors (capable of operating on any combination of gasoline and ethanol) have led to ethanol consumption in everyday life. Yet the sooner we start, the more opportunities we will have to form our future regardless of constantly appreciating oil and gas. At the same time, we cannot say that the world thirst for gasoline will not grow: as long as China and India are developing so rapidly, you may forget about fuel prices of $10 or $20 per barrel. However, despite all technological problems, the world is starting to understand that the epoch of affordable and pure ethanol is much more realistic than the hope for the return of cheap and inexhaustible oil, and we must take this into account in order not to watch the last train go again.

A.R. Ablaev
Vice President of the Russian Biofuel Association

THE KYOTO PROTOCOL AND ENERGY SAVING IN RUSSIA

The Kyoto Protocol (KP) to the UN Framework Convention on Climate Change (UN FCCC), adopted in 1997, ratified by Russia in 2004, and, owing to this, effective since 2005, sets not only limitations to greenhouse gas (GHG) emissions for developed countries but also makes it possible to trade GHG emission reductions within the framework of the so-called flexibility mechanisms. Overall, there are three such mechanisms: joint implementation project (article 6 of KP), the mechanism of clean development (article 12 of the KP), and trade in emissions (article 17 of the KP).

The essences of the first two mechanisms are very close. It is the ability to sell and buy GHG emission reductions, achieved as a result of project implementation in some countries, and to credit these purchased emission reductions to fulfilled commitments to the limitation and reduction of GHG emissions set by the Kyoto Protocol for other countries. Since GHG emission limitations were set only for developed countries (the so-called countries of FCCC Appendix I), these countries, as a rule, act as the buyers of design emission reductions. The sellers may be developed countries (and then, we speak about joint implementation project), as well as developing countries that have no commitments to limit and reduce emissions (then, it is the mechanism of clean development). For each of these mechanisms, relevant international bodies were established (the Executive Committee for the clean development mechanism and the Joint Implementation Supervisory Committee for joint implementation); rules and procedures were defined; and both committees are presently active in forming a special carbon market.

The main players in this market are increasingly becoming not the governments of the KP member states but commercial firms and companies that compete with one another (on the demand side, for projects, and on the supply side, for advantageous buyers) and create a dynamic market environment, which is reflected by prices. Today, from US $5 to €12 are paid for 1 t of emission reductions, depending on seller-guaranteed deliveries. According to forecasts, prices are to grow.

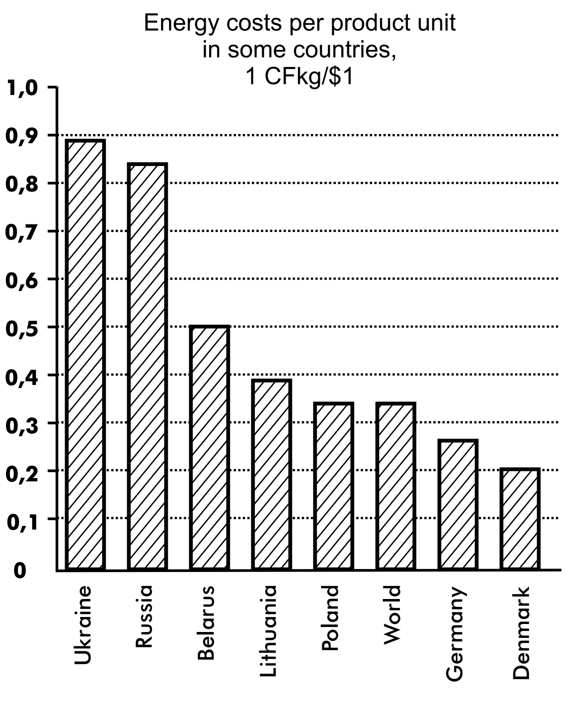
The third mechanism – trade in emissions (in fact, quotas on emissions) – does not operate at present, and nobody knows whether it will work at all. Most probably, it is a sort of a safety mechanism designed for emergencies. However, a number of countries, including Russia, are discussing trade in «green» quotas on GHG emissions, or the mechanism of «green investments». Its essence is the target channeling of revenues from GHG emission quota sales to environmentally important projects and, primarily, to GHG emission reduction projects. In this case, we are left with what is very similar but reverse to joint project implementation. Under joint project implementation, first, you have to reduce GHG emissions and then receive money for this, while the «green investments» pattern implies that money comes first. Although it is not that simple and definite.

The Kyoto Protocol creates economic incentives for energy saving. You only have to use them aptly.

Out of the three aforementioned KP mechanisms, Russia already today has an opportunity to use the first one – the mechanism of the joint implementation of emission reduction projects. This mechanism not only offers us much money, estimated at billions of dollars. It creates powerful economic incentives for modernizing the Russian economy and, primarily, for solving one of the most fundamental problems – the reduction of the energy intensity of the Russian GDP.

The Kyoto chance, or how to gain twice on energy saving

The empyreally high energy intensity of the Russian economy is not just a proverb. Today, it is a deterrent to socioeconomic growth and one of the key causes of the low competitiveness of our economy. By the consumption of conventional fuel per $1 of the GDP, we lag behind all the world's leading countries.



Meanwhile, the conditions of the Kyoto Protocol allow us to gain twice on energy saving. First, we can sell liberated energy resources in the international market. Moreover, experts hold that it is often cheaper to save 1 CFT of energy than to produce (extract) it. This seems to be gain number one.

The problem, however, lies in the fact that some save energy and fuel and others sell them in the market, including the international market. This objective contradiction most often stalls this incentive, especially under conditions where domestic fuel and energy prices lag far behind the world prices. This is exactly what we have in Russia today. Of course, we can try to raise domestic fuel and energy prices for consumers to feel the difference and start investing into energy saving. Yet energy price increases hurt, and not every economy can withstand them. The more so, not every government can afford it.

Here comes to rescue the Kyoto Protocol. The point is that greenhouse gas emissions are primarily related to energy, more precisely, to the combustion of fossil fuel in energy units. Consequently, energy saving, i.e., a decrease in energy consumption, other conditions being equal, gives a direct reduction of greenhouse gas emissions. Under the Kyoto Protocol, emission reductions are a commodity with a market price. What is more important, this commodity, unlike saved fuel and energy, belongs to those who have invested into new energy-saving technologies. Even if emissions are reduced not at an enterprise itself but at the neighboring heat and power plant, from which the given enterprise receives heat and electricity, all the same, the GHG emission reductions will be assigned to the project implemented at this enterprise. And this is pure gain, which the enterprise will receive in hard currency.

Note also that, for the purposes of the Kyoto Protocol, emission reductions are counted not in relation to the level that was before project implementation but in relation to emissions that would have been in the absence of the project, i.e. with regard to the comparable product output. This means that emission reductions are possible even under production growth, if, of course, this production growth is based on new technology.

Thus, the Kyoto Protocol objectively stimulates transfer to energy-saving technologies, providing companies with an opportunity to earn money by selling GHG emission reductions.

Russia's energy-saving potential: the Kyoto measurement

In a wider sense, energy saving may occur in the energy industry itself (owing to the reconstruction of generation capacities and the reduction of specific fuel consumption through efficient energy deliveries), as well as in energy-consuming industries (owing to the introduction of more progressive technologies that need less fuel and energy per product unit).

Let us take Russian ferrous metallurgy as an example. As is known, ferrous metallurgy is one of the most energy intensive industries, and it is not by chance that it occupies the second place in GHG emissions in Russia, following the energy industry[1]. The specific indices of energy consumption by the industry exceed substantially levels reached by the EU countries.

True, in recent years, the energy intensity of ferrous metallurgy has been somewhat reduced. At the end of 2005, energy consumption per 1 t of cast

[1] Third National Communication of the Russian Federation, Submitted in Accordance with Articles 4 and 12 of the United Nations Framework Convention on Climate Change.

Specific energy consumption by ferrous metallurgy in Russia and the EU, Mcal/t of product (2000)

Product type	Russia	EU
Coke	744	600
Sinter cake	512	627
Pig iron	4327	2646
Basic oxygen steel	462	133
Martin steel	1302	–
Hot-rolled products		
- from section	889	702
- from ingots	1194	1007

iron decreased 4% compared to 2000; per 1 t of finished steel, 10%; and per 1 t of electric steel, 10%. However, on the whole, the technological structure of production in the industry still lags considerably behind the world. For example, the share of electric steel in Russia hardly exceeds 20%, although it has already exceeded 35% in the rest of the world. The share of the Martin method of steelmaking in Russia is 20.4%, while in the world, this almost extinct method yields only 3.6%, and one-third of this volume falls on Russia.

This is, no doubt, bad news. On the other hand, the good news is that Russian ferrous metallurgy has a great potential for the reduction of energy intensity and, consequently, for the reduction of greenhouse gas emissions. Overall, according to the opinion of the specialists of the Central Ferrous Metallurgy Research Institute (TsNIIChM), this potential is 30–35%, or 8 million tons of CO_2 equivalent a year.

Thus, the replacement of Martin furnaces with electric furnaces will make it possible to reduce GHG emissions by 0.5 t of CO_2 equivalent per 1 t of steel. Therefore, for the whole amount of Martin steel (13.5 million tons a year), the reduction of GHG emissions will be 0.5 t of CO_2 equivalent/t x 13.5 million tons = 6.75 million tons of CO_2 equivalent.

According to the forecast of TsNIIChM's specialists, between 2008 and 2012 (the KP commitments period), the carbon intensity of production in ferrous metallurgy will decrease from 3.786 to 3.243 t of CO_2 equivalent per 1 t of steel, and the production of steel will increase from 70 million to 72 million tons. It is easy to calculate that the reduction of GHG emissions converted to comparable steel output will be (3.786 – 3.243) t of CO_2 equiv./t x 72 million tons = 39.1 million t of CO_2 equiv., which, even at a very modest price of €8 per ton of CO_2 equiv., will allow the industry to earn additionally in the carbon market: 39.1 million tons of CO_2 equiv. x €8 = €312 million.

Here, we do not necessarily speak about large-scale projects. Local measures within the existing technologies and even within individual processes, like ore concentration; sinter cake production; the coke-chemical, blast-furnace, converter, fire-resistant, rolling, and pipe-milling methods; and in the energy industry, can also yield the effect of emission reduction.

The industry's first joint implementation project to reduce GHG emissions under KP article 6 was proposed by OAO Ural Steel and supported by the world's leading carbon company Camco International (Britain) and the National Organization for the Support of Carbon Absorption Projects (Moscow). The project envisages a reduction of resource and energy intensity in steelmaking by expanding and modernizing electric steel production and introducing more productive technologies of continuous steel casting, which will help reduce GHG emissions by 3.1647 million tons of CO_2 equivalent from 2008 through 2012, or by 632,900 t of CO_2 equivalent on average per year. There are estimates that the sales of GHG emission reductions will cover no less than 20–25% of project implementation costs.

Another interesting example is the cement industry. Specialists consider it one of the most energy intensive industries. It takes 2–3% of global energy consumption and produces up to 8% of global GHG emissions.

In addition, specific GHG emissions depend substantially on cement production methods and fuel types used in furnaces. The most efficient is the dry method. The specific energy consumption of the dry method is from 3–3.5 GJ/t of clinker (using the most advanced six-step process pattern) to 4–4.5 GJ/t of clinker (using the four-step process pattern). Wet production energy costs are 6–7 GJ/t of clinker.

Russia and the CIS produce the larger part of cement (up to 80%) by the wet method, while the rest of the world favors the dry method.

It is easy to calculate that transfer to the dry method would almost double fuel savings in cement production and, consequently, would halve GHG emissions. It is not by chance that the first joint implementation project announced in the field of GHG emission reduction in the cement industry (the modernization of the Podol'sk Factory in Ukraine) envisages transfer from the wet to dry technology of cement production. In Russia, the first such project is expected to be implemented at OAO Podgorenskii Tsementnik in Voronezh oblast.

Another efficient method of reducing GHG emissions is transfer form coal and fuel oil to natural gas or biofuel. Converted to conventional fuel, the GHG emissions of natural gas combustion are approximately 30% lower than those of fuel oil combustion and 40% lower than those of coal combustion. Transfer to biofuel would practically result in a 100% reduction of GHG emissions, because CO_2 emissions from biomass combustion are considered climatically neutral and are assumed zero for the purposes of the Kyoto Protocol. Measures aimed toward the utilization of the heat of exhaust gases and other energy-saving measures may also be viewed as projects to reduce GHG emissions.

The reduction of CO_2 emissions resulting from the burning of fossil carbonates ($CaCO_3$ and $MgCO_3$) in clinker production increases additives that do not degrade quality but reduce the demand for clinker per ton of ready cement. Ash, metallurgical sludge, etc. can be used as additives. Additives may be used both at the stage of primary mix preparation in clinker production (before putting to furnace) and at the stage of cement production proper.

Russia's first joint implementation project in the cement industry was developed at OAO Savinskii Cement Factory with the participation of Camco International. This project envisages the transfer of clinker furnaces from black coal to natural gas. In addition to the reduction of fuel consumed by process furnaces, energy consumption is also reduced, because there is no need for coal mills. This, in its turn, leads to an additional decrease in GHG emissions at power plants that burn fossil fuel, which is, according to the KP rules, also credited to the project. The project results in a reduction of GHG emissions by 1.123 million tons of CO_2 equiv. from 2008 through 2012, or by 224,600 tons of CO_2 equiv. on average a year.

How joint implementation projects are done

The qualification of a project as a joint implementation project (JIP) begins with the development of project substantiation documentation. Documentation is developed according to an established uniform format and includes project description, project GHG emission estimation, baseline research (GHG emission forecasts without the project), the estimation of expected reduction of GHG emissions as a result of project implementation, project additionality substantiation, project environmental impact assessment, a monitoring plan, and other necessary documents, including project approvals at the local and regional levels.

Then, the project is examined by an accredited independent body (auditor), on the results of which a decision is made to approve and register the project as a JIP by the authorized body of the host party (i.e. the country where the project is implemented), the authorized body of the investor party (i.e. the country where the buyer of emission reductions is stationed), and the Joint Implementation Supervisory Committee that supervises joint implementation.

To this day, the JIP approval and registration procedure in Russia has been coordinated by the key departments and is expected to be adopted by the Russian government in the nearest future.

As for project approval by the investor party, many countries have already adopted this procedure, and the solution to this issue is nothing but a technical matter, although highly professional. Moreover, subject to the requirements of the Joint Implementation Supervisory Committee, projects must be approved by the investor party within a year since its approval by the Committee.

Actual emission reductions as a result of project implementation are annually monitored, measured, and acknowledged by the accredited independent body (auditor), generally by the same one who examined project documentation before that. The monitoring report is approved according to the established procedure by the authorized bodies of the host and investor parties and by the Joint Implementation Supervisory Committee.

After that, special carbon units – Emission Reduction Units (ERU) – are emitted in the carbon register of the host party; then, ERU are transferred to the register of the investor country, based on the deal concluded by the project owner with one or several interested foreign buyers.

M.A. Yulkin
Camco International, Director, JIP

CLIMATE AS AN ECONOMIC PROBLEM

From climatic theory to economic practice

The characteristic feature of scientific papers and reports on climate change in 2006 was a very sharp change in the topic and tone of discussion. From political slogans and «sensational» forecasts of the period of signing the Kyoto Protocol (2003–2004), the scientific community has quietly shifted to more «down-to-earth» and practical things. It was by the beginning of 2006 that the necessary potential of scientific knowledge was accumulated to make the conclusion: it is no less than 90% probable that the current sharp climate change over the past decades was caused by the anthropogenic discharges of greenhouse gases[1]. Of course, the number of unsolved scientific problems has not decreased because of that, the discussion of the causes of the observable climate change has just been replaced with discussions of, for example, the ocean's role in atmospheric CO_2 absorption, methane emissions during a deeper summer thawing of the permafrost, etc. Since the cause is, alas, anthropogenic, and discharges must be reduced, the issue was put in the practical plane.

First, we had to answer the question: what climate change is more or less acceptable for nature and humans. In addition, enough of scientific information was accumulated by 2006 to conclude: 2ºC of global warming are the borderline that we better do not overstep[2]. If, at two degrees, «only» 500 million people will suffer from freshwater shortages by the mid-century, then, at three degrees, their number will grow to 3 billion. Such a sharp leap will, of course, be a strong blow on the global economy and, primarily, on developing countries. Therefore, the issue has already passed from the environmental field to economics.

Enough of scientific information was accumulated by 2006 to conclude: 2ºC of global warming are the borderline that we better do not overstep. If, at two degrees, «only» 500 million people will suffer from freshwater shortages by the mid-century, then, at three degrees, their number will grow to 3 billion. Such a sharp leap will, of course, be a strong blow on the global economy and, primarily, on developing countries. Therefore, the issue has already passed from the environmental field to economics.

The problem of the current climate (note that it is not paleoclimate, where we expect a new glacial period in thousands of years from now1) change was taken up by the leading economic organizations: the World Business Council on Sustainable Development, the International Energy Agency (IEA), PriceWaterhouseCoopers, the Alliance Financial Group, etc. In 2006, fundamental international reports and papers of scientific forums were published, in particular, Energy Technology Perspectives 2006[3]. These publications probe deep into the ways of world energy development, including scenarios for accelerated reduction of CO_2 discharges due to climate change.

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[1] IPCC, 2007, Fourth Assessment Report, Working Group 1. Climate Change, The Physical Science Basis. Presented on IPCC Conference in Paris, February 02, 2007, www.ipcc.ch

[2] IPCC, 2007a, Fourth Assessment Report, Working Group 2. Climate Change Impact, Adaptation and Vulnerability, Presented on IPCC Conference in Brussels April 06, 2007, www.ipcc.ch ; The Economics of Climate Change. 2006, The Stern Review. Nicholas Stern. Cabinet office – HM Treasury, UK, www.sternreview.org.uk (a review in Russian is at www.wwf.ru)

[3] IEA, 2006/ Energy Technology perspectives – 2006, OECD/IEA, 2006, 458 pp. www.iea.org (a review in Russian is at www.wwf.ru)

Carbon price as a new economic factor

We may surely conclude that, along with different scenarios of larger or smaller development of certain technology groups (renewable resources, nuclear power, accelerated energy supply, etc.), we always consider a carbon «price» scenario – the payment for various amounts of CO_2 discharges. In addition, this is considered not as a load on the economy but as an incentive for the market to move toward the use of new technologies. Predictions are generally made until 2050, breaking it into periods until 2015, 2030, etc. Therefore, the refined Russia's Energy Strategy until 2020, now under development, and its prolongation until 2030 must mandatorily include a scenario, better several scenarios, reflecting different discharge «prices». In the IEA report, it is \$25/t of CO_2 (and the oil price is \$60/bl); in other papers, it fluctuates from \$10 to \$50 (the current price in the EU market is about €6/t of prevented CO_2 discharges).

It is important to note that the «carbon price» affects national economies even if they do not take part in any quota trading systems and «Kyoto agreements». Already now this creates high demand for natural gas and in the long term for biofuel (to produce which, in particular, large land areas are needed). The introduction of «carbon intensity» standards for imported products (specific discharges duringy their production) is potentially a very strong pressure lever, etc.

Macroeconomic conclusions

Without going into the details of the above papers, we may mention the main macroresults.

(1) The global economy can, without material losses in GDP growth rates, reduce discharges to a level that would stop global warming by 2–2.5°C. This means that by 2050, after their peak in the 2020s, discharges will at least drop to the current level or will at best halve.

(2) Global energy generation does not have a single miraculous technology (for example, as thermonuclear power was perceived in the 1970s). We have to develop several of them simultaneously, where the «referee», who decides which will develop stronger, is purely economic considerations – the pragmatic calculation of costs and benefits. It is assumed that the environment will be strictly taken care of and the problems of nuclear power (and waste) security will be solved.

(3) Economic estimates show that the main role — about 50% of reduced discharges — is played by energy saving. Probably, for Russian citizens, this conclusion is quite obvious without any estimates. The second half toward 2050 will approximately be comprised of three components: renewable energy sources, nuclear power, and, from 2030, CO_2 recovery from discharges and its injection into underground formations. The latter technology gives «green light» to a wide use of coal. In principle, it has largely been developed and can be introduced before 2030; however, pure price calculations speak about large-scale profitability only in 20 years. Obviously, the role of nuclear power is not critical for climate. It is more likely to the contrary: it «needs» a climate problem – it is the carbon price that stimulates the use of nuclear power. It is now making Finland, France, and Bulgaria introduce atom, if, of course, we set aside their emotions concerning Russian gas dependence. There are many papers that solve the climate problem without its development into the next decades; it will just be a little more expensive economically.

(4) The next fundamental question is how much is the accelerated development of the energy industry based on new technologies? Traditionally, calculations here are made in units that affect GDP growth. These calculations are more complex and less developed than assessment of the mutual competitiveness of technologies, described in the previous section. However, three general conclusions can be made already now: (a) a quite reasonable price – GDP growth decreases by 1–2 percent points; losses are greater from an «uncontrolled» climate change, estimated at 5% of the GDP and more; (b) «the chain is no stronger than its weakest link» — developing countries will suffer 2–3 times more losses than developed countries (both shortage of resources for adaptation of their economies and susceptibility to draughts — the main tragedy of climate change — will tell on these countries); and (c) under sound control over this process, some countries may avoid losses.

Russia's role

The last macroeconomic conclusion – «under sound control over this process, some countries may avoid losses» — is very interesting for Russia. It is stated that, for some northern countries, if climate change is kept within 2°C (of global warming, the effect in Moscow will be 2 times; in Yakutia, 3–4 times; and in the Arctic, 4–6 times higher), GDP will not drop under sound control but will grow by 1 percent point faster[4]. Of course, under our plans of 5–6%

[4] The Economics of Climate Change. 2006, The Stern Review. Nicholas Stern. Cabinet office – HM Treasury, UK, www.sternreview.org.uk (a review in Russian is at www.wwf.ru)

long-term growth, the addition of a «unit» does not look very critical. However, another conclusion is minus one point under incompetent control, and a difference of 2 points is minimum one-third of the desired growth, which is too much.

In other words, the price of the issue for Russia is high, and any skepticism and certain disbelief in the new climate problem must be changed to sober economic calculations. An opinion is often heard that the main point for Russia is forests and that Russia is the «lungs» of the planet. Alas, scientific data show that our country's forests are far from being CO_2 net absorbers every year; sometimes, they are CO_2 sources because of the abundance of old forests, fires, etc[5]. Western Siberian swamps may be a global source of methane (greenhouse gas) emissions during permafrost thawing, which are much larger than the discharges of the Russian energy industry. Forests are, of course, the lungs of a community or a city but not a planet. The whole humanity lives on oxygen, which was accumulated millions of years ago, and its reserves are very large. Even the simultaneous burning of all fossil fuel would not lead to an oxygen deficit. Therefore, we must switch from discussions about the size of our territory and the «lungs of the planet» to economic calculations and specific actions.

It is very important to understand what sound actions are:

- Early adaptation of the economy to new climatic conditions. State support for future technologies, incentives for the private sector, and the introduction of these technologies.
- Maximum gain from «natural» economic advantages: the availability of natural gas, large areas for growing biofuel for export, hydropower for energy-intensive industries, fresh water reserves, etc.
- A strict international regime of discharge reduction, keeping the «carbon price» at a relatively high level (e.g., €20 per 1 t of CO_2) and leading to a limitation of global climate change at the 2 °C level by 2050. Alas, at 3–4 degrees of global change, Russia would suffer losses in any case, much larger than the cost of early transfer to new technologies.

Greenhouse gas discharges have been growing in Russia since 2000, but this growth is, first, on average 2–3 times smaller than GDP growth, and, second, suits well the scenarios of solving the climate change problem, according to which Russia's discharges will reach maximum in the 2020s and then will gradually drop. In addition, according to these scenarios, a drop will begin a little later in China and India in the 2030s and 2040s, etc.

Now the United Nations conducts talks on international commitments to discharge reduction for the period beyond 2012. It seems that a long-term outlook and economic factors for the development of the «carbon» market must be the main arguments. The market may be smaller (not including even some very large countries) but «stronger» in terms of commitments and the carbon price. Then this will allow Russia to implement its advantages, and, finally, make its worthy contribution to the planet's ecology and climate.

The World Wildlife Fund has joined the educational and analytical work to stimulate the three activity areas stated above. In 2007, with support of the British Global Opportunities Fund and jointly with State University – Higher School of Economics, a special analytical project was started whose results we hope to present in the following issues of this bulletin.

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[5] B. Sohngen, K. Andrasko, M. Gytarsky, G. Korovin, L. Laestadius, B. Murray, A. Utkin, and D. Zamolodchikov, World Resource Institute. 2005. Stocks and Flows: Carbon Inventory and Mitigation Potential of the Russian Forest and Land Base, WRI Report, 52 pp. http://pubs.wri.org ; The Fourth National Message of the Russian Federation on UNFCCC and the Kyoto Protocol / The Federal Service for Hydrometeorology and Environmental Monitoring (ANO Meteoagentstvo Rosgidrometa, Moscow, 2006), 164 pp.; UNFCCC. National Inventory Reports. Russian Federation. Common Reporting Format. 2007. www.unfccc.int

THE POTENTIAL AND PRICE FOR REDUCING GREENHOUSE GAS EMISSIONS

The continuing and seemingly uncontrollable growth of greenhouse gas concentrations in the atmosphere, which is 90% predetermined by human economic activities, leaves no doubts about what the world community must do to mitigate the current and future climate change. A significant but gradual decrease in greenhouse gas discharges is practically the only possible answer of humanity to the global challenge of climate change. Various measures, branded as «geoengineering», like displacing the Earth's orbit with the help of nuclear explosions in space and dispersing sulfate aerosols in the upper atmosphere and the stratosphere, cannot be treated seriously if, of course, humans are still ready to fight for life on this planet and are not going to do away with it. It finally seems that the world has reached a consensus that a reduction of discharges is in every way good both for humans and the environment. Only the issues of distributing responsibilities for payments for such reductions remain discordant. When? How much? and Who must pay? are the key questions of the current world policy aimed toward climate change mitigation. To approach answers, it is necessary to determine the level of greenhouse gas concentrations in the atmosphere that may be acknowledged acceptable for both climate and the economy. Knowing this value and accepting it as the global target in the struggle with climate change, it is possible to evaluate the cost of reaching it. In recent years, greenhouse gas concentrations in the atmosphere ranging from 450 to 550 ppm of CO_2 equivalent have been considered as such a target. Why is it so important not to allow the greenhouse gas concentration to exceed a certain borderline? Why is it necessary to «hold» to a specific level? The point is that there is a close interrelation between the concentration level and air temperature. The current temperature increase of 0.7°C, compared to the preindustrial epoch (280 ppm of CO_2 equivalent), turned out adequate to a concentration growth to 430 ppm of CO_2 equivalent. And there are serious reasons to believe that a temperature growth of 5–6 degrees may lead to inevitable consequences in the planetary ecosystems, which would disturb their ability to absorb greenhouse gases from the atmosphere. These changes would be accompanied by a serious increase in carbon dioxide emissions from soils and methane from the permafrost, which would increase their atmospheric concentrations even greater and would destabilize the climate system even greater. In addition, we must remember that even an immediate and total cessation of greenhouse gases discharges would not lead to an immediate stabilization of their concentration level in the atmosphere. Concentrations would continue to grow owing to previously produced discharges. Thus, to reach the desired target of, say, 550 ppm of CO_2 equivalent, we will need significant discharge reductions for a long period. For example, if maximum discharges occur in 2015–2025, in the following years, we will need their reduction at least by 1–3% per year. Under such an approach, the level of discharges in 2050 will be 25–75% lower than the current level, but the target of 550 ppm of CO_2 equivalent will be achievable. Note that such discharge reductions must be carried out during continuous global economic growth. According to

In any case, the costs of reducing greenhouse gases produced now and in the next few years will be incomparably smaller than the costs of mitigating the negative or even catastrophic consequences of future climate change.

the available estimates, the global GDP in 2050 must exceed the current GDP 3–4 times. Consequently, the carbon intensity of the GDP unit under discharge reductions must drop by the corresponding value.

The available estimates of the necessary expenditures on the reduction of greenhouse gas discharges by 2050 by approximately 75%, compared to the current level, indicate that we must spend from –1 to +3.5% of the global GDP a year. An averaged estimate yields 1%. A pretty wide range of estimates is predetermined by a high degree of uncertainty in the development of innovative low-carbon technologies, as well as by the growth rate of prices for hydrocarbon raw materials. In addition, the costs of reducing greenhouse gas emissions will differ depending on where these reductions are made. It is clear that the cost of emission reduction measures, for example, for 1 t of carbon dioxide of an energy unit in a highly efficient economy and in a developing economy will be different. In the first case, the price may be tens of times higher. The cost of measures to reduce greenhouse gas emissions includes expenditures on the development and introduction of highly efficient technologies that help reduce emissions, as well as the consumer costs of transfer from goods and services based on processes with a high level of greenhouse gas emissions to low-emission products. Transfer to this economic model requires, primarily, large-scale measures, which may be reached by different ways, to reduce greenhouse gas emissions generated by fossil fuel combustion. These measures include reduced demand for «high-carbon» products, increased energy efficiency, and low-carbon technologies. Reduced demand for high-carbon products implies that the product price includes a component that reflects the extent of processes involving high greenhouse gas emissions. The more emissions the higher this component is, and, consequently, the price. Individual consumers and private companies would react naturally by choosing cheaper low-emission products. For example, calculations made for Britain demonstrate that the introduction of a US $30-worth carbon component into the product price for 1 t of CO_2 emissions would raise retail prices by 1% on average. However, this is «on average», and, if there are more tons, the price will be higher. It is clear that the buyer would have to be geared to less carbon-intensive products. An increase in the level of awareness and concern about climate change materially affects demand too. However, one factor of decreasing demand for high-carbon products alone cannot solve the problem of reducing greenhouse gas emissions.

Improved energy efficiency is an opportunity to save energy and resources by reducing greenhouse gas emissions. The use of less fuel for heat generation to keep a preset indoor temperature or a smaller consumption of gasoline by an automobile to drive 100 km are the simplest examples of higher energy efficiency. The potential of measures to reduce greenhouse gas emissions by more efficient use of energy is very high. Over the past century, energy efficiency in developed countries increased tens of times and more. For example, historical research into electric power production in Britain shows that, in 1891, 10–25 lb of coal were used to produce 1 kWh; in 1947, 1.5 lb; and now, 0.7 lb. According to the International Energy Agency's data, energy efficiency measures would make it possible to reduce annual greenhouse gas emissions by 16 Gt of CO_2 equivalent by 2050.

Alongside energy efficiency measures, it is necessary to develop and introduce a wide range of low-carbon technologies. At present, different industries already have these more efficient and cleaner technologies: heat and power production, transportation, industry, etc. Unfortunately, they are, in many cases, more expensive than traditional technologies based on fossil fuel combustion. Their cost in the future will probably decrease, but there is still a lot of uncertainty in this process. Renewable energy sources, such as wind energy, tidal power plants, solar batteries, hydroelectric power, biofuel, and hydrogen, occupy a substantial place among these technologies. Nuclear power is special due to controversial attitudes of some people, as well as countries, to it. However, a number of countries, including Russia, are putting new-generation reactors in operation. The development of carbon absorption and burial technologies has widely been discussed lately. The attractiveness of this solution lies in the fact that, if this technology is widely used, it will make it possible to continue to use widely fossil fuels in the medium and long term. According to IPCC data, the potential for carbon burial in geological structures is 1700–11100 Gt of CO_2 equivalent, which equals the withdrawal from the atmosphere of an amount of CO_2 that was discharged during fossil fuel combustion for 70–450 years.

A number of studies apply a technological approach to estimating the cost of measures to reduce greenhouse gas emissions from fossil fuel combustion. The International Energy Agency conducted its own research, which showed relatively low costs of discharge reduction. This research assumes that discharges from fossil fuel combustion will first grow and then will decrease to 18 Gt of CO_2 a year by 2050 due to the combined use of energy efficiency measures and low-carbon technologies.

Analysis of possible discharge reductions, which is based on the technological approach and which implies a reduction of greenhouse gas emissions by about 75% of the current level by 2050, assumes that this year, about US $1 trillion will be spent on discharge reduction, which is about 1% of the global GDP. The average cost of reducing 1 t of carbon under this approach is determined by calculating the cost of reduction by each technology compared to the cost of adequate reductions reached under fossil fuel combustion.

In addition to measures aimed toward reducing greenhouse gas emissions as a result of fossil fuel combustion, a great CO_2 reduction potential lies in human activities related to agriculture and forestry. Overall, «nonfuel» emissions of greenhouse gases are presently evaluated at 40% of the global level of emissions. Almost 20% (8 Gt of CO_2) of global carbon dioxide emissions are related to deforestation processes. Planting new forests may lead to additional binding of at least 1 Gt of CO_2 a year. The cost of 1 t of CO_2 is valued at $5–15 per 1 t of CO_2. According to IPCC data, the carbon dioxide absorption potential of forestation is 4–6 Gt of CO_2 a year for the 1995–2050 period, 70% of which falls on the countries of the tropical belt. Changes in agricultural and land management practices may lead to a reduction of emissions by 1 Gt of CO_2 a year by 2020; other estimates predict a reduction of 1 Gt of CO_2 a year by 2030. The cost of reducing 1 t of CO_2 is $20.

The above research data and the related evaluations of the potential for reducing anthropogenic emissions of greenhouse gases allow us to look with careful optimism into the future development of humanity. The good political will of country leaders, reasonable economic policies of large private corporations, and, no doubt, readiness of each person to change slightly his or her behavioral model would make the problem of overcoming climate change quite possible. In any case, the costs of reducing greenhouse gases produced now and in the next few years will be incomparably smaller than the costs of mitigating the negative or even catastrophic consequences of future climate change.

After reaching a consensus on the target of the global climate policy, it is very important to agree on the participation in its implementation of each country in the world. It is naive to believe that under the current increasing globalization, some one will be able to «sit on the fence» and outwait the unfavorable period in the life of humanity. All countries of the world will have to take measures against climate change. Another point is that the costs of reducing greenhouse gas emissions and adapting to climate change must and will differ greatly from country to country. The largest countries of the world are already making serious efforts to mitigate climate change. For example, the European Union has established the world's largest intergovernmental system of trading greenhouse gas emission quotas, which has already helped increase investments into low-emission technologies both in Europe and in developing countries. The Chinese 11th five-year plan envisages very ambitious goals to reduce GDP energy intensity by 20% over the 2006–2011 period. India is increasing the share of renewable energy sources in the country's balance and encourages energy efficiency measures.

The implementation of climate policy aimed toward the reduction of greenhouse gas emissions leads to restructuring, primarily, the energy industry, as well as other high-carbon industries. Transfer to the global economy aimed toward low emissions of greenhouse gases opens new opportunities in a wide range of human activities. The development of such a low-emission economic model is a global benefit in itself, which accompanies the targeted and systemic reduction of greenhouse gas emissions through the economic and environmental effects of reducing the combustion volumes of fossil fuels. The size of the current RES-based energy market is estimated by experts at $38 billion. The number of employees in this industry worldwide is 1.7 million. In 2005, the growth of this energy sector was about 25%. Some industries show even higher growth rates. For example, the number of units on solar batteries in 2005 grew 55%. The potential of the market of low-carbon energy products is valued at $500 billion a year by the mid-21st century. In addition, measures to reduce greenhouse gas emissions are accompanied by the reduction of the discharges of traditional atmospheric pollutants (SO_2, NO_x, and solid particles), which favorably tells on human health and the environment. Studies conducted by the European Environmental Agency show that the implementation of measures to reduce greenhouse gas emissions that are adequate to a more than 2ºC temperature increase would reduce the costs of the European health care sector by €16–46 billion a year.

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RUSSIAN ENERGY POLICY IN THE CONTEXT OF THE KYOTO PROTOCOL

The electric power industry is the largest polluter of the environment, affecting negatively the air basin, water and land resources, climate, human health, etc. This industry holds the first place among other industries in the amount of hazardous emissions into the atmosphere, being the main source of pollution of urban air basins. In the past decade, Russia has reduced the hazardous discharges of electric power enterprises into the atmosphere, which is due to a drop in electric power output and an increase in the shares of natural gas and low-ash/low-sulfur coals in the fuel balance, as well as measures aimed to inhibit nitrogen oxide formation in boilers and to improve the efficiency of ash-extracting units. At the same time, the growth of electric power output, not accompanied by environmental measures, creates increased emissions of hazardous substances into the atmosphere.

The environmental aspects of the operation of the electric power industry have become especially topical in relation to Russia's ratification of the Kyoto Protocol (1997). Its mechanisms and the country's commitments, related to the prevention of global climate change, may influence the development of the electric power industry. Now we have a lively discussion of whether Russia's commitments to the Kyoto Protocol limit economic growth. According to the overwhelming majority of opinions, they do not. This is proved by the prognostic assessments in the Third National Communication of the Russian Federation, which say that, even under a rapid economic growth and restructuring, CO_2 emissions in 2015 will not exceed 85–90% of the 1990 level.

For Russia to fulfill its international commitments under the Kyoto Protocol, it is important to evaluate the emissions of greenhouse gases when planning and predicting the energy industry's development. It is advisable to supply medium- and long-term forecasts for the development of electric power with calculations of the environmental consequences of proposed economic changes in the industry and with the definition of compensatory measures.

For Russia to fulfill its international commitments under the Kyoto Protocol, it is important to evaluate the emissions of greenhouse gases when planning and predicting the energy industry's development. It is advisable to supply medium- and long-term forecasts for the development of electric power with calculations of the environmental consequences of proposed economic changes in the industry and with the definition of compensatory measures.

Assessment of the environmental consequences of the electric power industry's development and the size of carbon credit for this industry depend on developmental scenarios for this industry. Under an optimistic scenario with the radical restructuring of energy facilities and the reduction of energy intensity, Russia will in no way exceed the 1990 emissions of greenhouse gases. However, the large-scale restructuring of the fuel balance with transfer from gas to coal may cardinally change the situation.

A lasting decrease in emissions in the energy industry depends on the reduction of emission intensity. The reduction of greenhouse gas emission intensity is obtained by transfer to fuel with a lower carbon content (for example, a transfer from coal to natural gas or renewable energy sources). All European countries have achieved a reduced intensity of greenhouse gas emissions over the past decade. The highest reduction of intensity and the lowest level of emission intensity were reached in Germany. More extensive use of coal in Central and Eastern Europe explains the high intensity of greenhouse gas emissions in these countries.

The flexibility mechanisms of the Kyoto Protocol provide Russia with great opportunities in energy saving: the improvement of energy efficiency, the use of secondary energy resources, and the restructuring of natural gas consumption. To this end, huge nongovernment internal and external investment resources can be attracted.

The key reserves for reducing the emissions of greenhouse gases are concentrated in the improvement of energy efficiency and the reduction of energy intensity. The energy intensity of the Russian GDP is 3–10 times higher than that of industrially developed countries. This is due to technical and technological backwardness, high wear and tear of the fixed assets in the economy's real sector (primarily, the energy industry) and in the social sphere, structural distortions of the Soviet economic period, climatic conditions, and unequal distribution of energy resources and their consumers on Russian territory.

About 50% of public heat supply facilities and engineering networks need replacement, at least 15% are in a dangerous state. Every 100 km of heat grids are annually recorded to have 70 breakdowns on average. Losses in the heat grids amount to 30%. In addition to heat losses, heat-carrier leakages annually lose more than one-fourth of a cubic kilometer of water. 82% of the total heat grid length need capital repairs or complete replacement.

According to available estimates, the engineering potential for the use of renewable energy sources (RES) in Russia is about 4.6 billion conventional fuel tons (CFT) a year, i.e., it exceeds 5 times the consumption of all Russia's fuel and energy resources, and the economic potential is measured at 270 million CFT a year, which is slightly more than 25% of Russia's annual domestic consumption. At present, the RES economic potential has increased significantly owing to the appreciation of traditional fuel and the depreciation of renewable energy equipment in recent years.

The environmental evaluation of the replacement of natural gas with coal in the fuel balance of heat and power plants is largely determined by how «liberated» natural gas will be used. There is the most environmentally preferable field of the energy industry's development in the long term. With a higher coal share in the fuel balance of the electric power industry, negative environmental consequences will be compensated by the introduction of progressive coal transportation and combustion technologies and exhaust gas treatment processes. Simultaneously, the redistribution of liberated natural gas into the sphere of decentralized heat supply in order to reduce the scope of solid fuel combustion will make it possible to stabilize or reduce the total discharges of hazardous substances into the atmosphere.

The negative impact of environmental pollution on human health is great. According to expert evaluations, a large-scale transfer of electric power enterprises from natural gas to coal produces the highest risk for human health. In case of active replacement of natural gas with coal, the average mortality rate in Russia may increase 16.3%, and the total economic loss for the population already in 2010 will be $€_{2000}$31.4 billion (+21% compared to 1999).

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