

Russian Energy Strategy 2020: Balancing Europe with the Asia-Pacific Region

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Introduction

Initially, the Russian government approved the *Main Provisions of the Russian Energy Strategy to 2020* on November 23, 2000. Before long, various economic, administrative and legislative factors, including reforms in the natural gas and power sectors, prompted the revision of the document. The new version of the *Energy Strategy to 2020* was approved on May 22, 2003. Some of the document's key parameters and long-term targets became more detailed and ambitious, while external priorities for developing the energy sector were also set out.

Russia is the world's second largest exporter of oil and the leading exporter of energy in all its forms, including natural gas and oil products, coal and also some electricity. The *Energy Strategy 2020* approved on May 22, 2003 envisages the expansion of the energy sector (Table 1) and the growth of energy exports, particularly to Asia.

Table 1. Russian Energy Production and Exports, 2002-2020

	Production		Exports, US\$ billion	
	2002	2020	2002	2020
Oil (million tons)	380	450-520	184	140-310
Oil products (million tons)	135	146-166	75	30-50
Natural gas (billion m ³)	590	680-730	185	235-245
Coal (million tons)	253	375-445	47	55-60
Power generation (billion kWh)	892	1,215-1,365	14	30-75

Source: Ministry of Energy

The main purpose of this overview is to clarify the prospects for energy links between Russia and Europe, on the one hand, and Russia and the Asia-Pacific region (primarily Northeast Asia), on the other. The future of Russia's energy cooperation with these two parts of the world deserves careful assessment based on (1) Russia's domestic priorities, (2) its potential to fulfill the role of a massive energy supplier, and (3) the capacity of Russia's

eastern neighbors to support this potential. The outcomes of these and other factors probably allow us to speculate on both the nature and the depth of Russia's future energy links with Northeast Asia.

Background

In the opinion of many economists and politicians, the gloomy side of this exceptional position is Russia's overwhelming dependence on the energy sector. Energy industries occupy 25% of its GDP, providing for one-third of industrial output and consolidated budget revenues, as well as about half of export earnings and the proceeds of the federal budget. Another problem is that Russia's energy exports are predominantly destined for Europe.

The European Union (EU) makes no secret of the fact that its increasingly high and growing import dependence on Russia has to be kept within certain limits.¹ Similarly, Russian energy planners propose to diversify energy exports, accessing new oil and gas markets in the Asia-Pacific region, Northeast Asia in particular. The government is proposing to diversify energy supplies to the "north, east and south", promoting energy production in new, capital-intensive environments, including Eastern Siberia, the Far Eastern region, the Arctic and the continental shelf of the northern and Caspian seas.

The economies of Northeast Asia and possibly the United States are emerging as potential new targets of Russian oil producers and exporters of natural gas. Recent policy trends support these intentions. In May 2002, Moscow and Washington launched their "new energy dialogue". Beijing has been successful in lobbying for an export pipeline with a capacity of 30 million tons (Mt) from Angarsk to Daqing that would deliver to China as much as 700 Mt of oil by 2030.²

In January 2003, a yet larger oil pipeline project from Angarsk to Nakhodka (capacity of 50 Mt) received support from the Japanese Prime Minister Junichiro Koizumi.³ Energy cooperation became part of the Japan-Russia Action Plan adopted in January 2003. In 2002-2003, the Russian Energy Ministry held high-level consultations with counterparts in Japan, China, South Korea and Mongolia.

¹ *Energy: Let Us Overcome Our Dependence* (Luxemburg: European Commission, 2000), p. 13.

² A pipeline to Daqing will deliver about 700 Mt of oil by 2030. It will be linked to oil reserves in Western Siberia that have already been explored and proven. For China, the option of investing in overseas exploration and development would be significantly more expensive than pipeline construction. At present, China controls more than 500 Mt of oil reserves overseas. By 2005, CNPC plans to produce 35 Mt of oil a year overseas but could only obtain about 18 Mt based on its equity holdings.

³ At a meeting in St. Petersburg on May 20, 2003, Prime Minister Koizumi asked President Putin to approve the extension to the Angarsk-Daqing pipeline, bringing it to the Pacific coast. The indication is that the Japanese government plans to encourage companies to sign up for exploration projects in the region and thus fill the financing gap (see Troika Dialog, Russia-Equity Market, June 2, 2003, p. 4).

It is worth noting that the Russian Energy Minister was invited to the discussion table at the recent International Energy Agency (IEA) ministerial meeting. At the meeting, the Japanese and South Korean energy ministers stressed the importance of Northeast Asia and energy cooperation in this region. The Russian participant noted these views and the willingness to discuss prospects for cooperation with Russia. The South Korean minister even mentioned that his country plans to establish an organization to contribute to subregional energy cooperation and urged the IEA to assist with this process.

Mutual reliance

Russia's role in supplying oil and natural gas to Europe is well known. During the next three decades, the EU's energy production is expected to decline by about 17%, while net energy imports are expected to grow by 15%. The dependence of European countries on imported energy is high and growing, projected to rise to 70% by 2030. The level of external dependence for oil will reach 90%, while that for natural gas will approach 80%. Reliance on nuclear power is unlikely to expand without a broad public and policy consensus, not to mention a solution to the problem of disposing of nuclear waste.

The war in Iraq reasserted Russia's key position in meeting the energy needs of Europe's economies. Russian energy exports account for 45% of all exports to the EU. More than 80% of Russian oil exports (crude oil and oil products) and more than 60% of its natural gas exports are shipped to Europe. On the other hand, in 2002, gas exports to Europe amounted to 129.5 billion cubic meters (Bcm), covering 26% of its overall gas consumption, including 17% of the EU's total gas demand.⁴

Extensive energy links have made Europe and Russia economically interdependent, requiring closer policy coordination.⁵ A Green Paper published by the European Commission underlines the need for partnership with Russia, in its capacity as one of the key energy-producing economies. The sixth EU-Russia summit held in October 2000 in Paris proposed instituting an energy dialogue. The exploratory phase for this dialogue was completed by the eighth summit in 2001.

The concept of energy partnership covers oil, gas and electricity and aims to improve investment opportunities in Russia's energy sector, in order to upgrade infrastructure, promote efficient and environmentally friendly technologies and enhance energy conservation. The short-term goals include the improvement of the legal basis for energy production and transport, legal security for long-term energy supplies, the physical security of transport networks, new transport infrastructure projects of "common interest" and pilot projects in the field of energy

conservation.

How much is enough?

However, over the next two decades, Russia is not planning to expand its energy exports to Europe in physical terms. Contrary to expectations, including projections by the International Energy Agency (IEA), the *Energy Strategy 2020* basically reflects this change in priorities. Russian energy planners assume that in 2010-2020, oil exports could fluctuate between 140 and 310 Mt, depending on external and domestic circumstances.⁶ In the upbeat projection by the Energy Ministry, oil output could increase to 490-520 Mt in the course of the next decade or so, while domestic demand in 2010-2020 is estimated to level off at 200-215 Mt.

On the other hand, the *Energy Strategy 2020* stated that oil exports to the Asia-Pacific region could reach 105 Mt, including 25 Mt produced by the Sakhalin offshore fields. This new export direction would leave about 200 Mt for all other destinations, including CIS (Commonwealth of Independent States) and European markets. Oil exports to CIS economies are expected to increase, reaching 30-35 Mt beyond 2010, leaving about 150-160 Mt of crude oil for exports to Europe.

In 2001, combined oil exports from Russia and other CIS oil producers to Europe were 181 Mt. Whatever change in the volume of exports takes place over the next two decades, it seems unlikely that the Russian "contribution" will exceed current levels. On the other hand, exports of oil products are estimated to halve in 2020, falling from 75 Mt in 2002, which also signals a reduction in shipments to Europe.

The IEA's projections for natural gas production and exports differ from the *Energy Strategy 2020* estimates even more significantly. According to the IEA, Russia should reach a production volume of 710 Bcm by 2010. This is above the averaged target set by the government for gas output in 2020, including around 100 Bcm extracted in Eastern Siberia and the Far Eastern region, mostly by independent producers.

The IEA forecast that Russia would deliver about 200 Bcm of gas to Europe as soon as 2010, rising to 244 Bcm by 2030.⁷ The *Energy Strategy 2020* estimates that total gas exports will grow from 185 Bcm in 2002 to 235-245 Bcm by 2020, rather than the 280 Bcm proposed by the IEA. Exports to Europe are estimated at 160-165 Bcm, up 22-23% from the 129 Bcm exported in 2000, including 110 Bcm delivered to OECD members.

On the other hand, the authors of the *IEA World Energy Outlook 2002* suggested that the share of gas in Russia's total primary energy supply will rise from 52% to 56% by 2030, when in fact Russian officials want to reduce

⁴ Alexey B. Miller, "The Eurasian Direction of Russia's Gas Strategy", Keynote Address, 22nd World Gas Conference, Tokyo, June 4, 2003, p. 6. See also *Green Paper - Towards a European Strategy for the Security of Energy Supply* (Technical Document), European Commission, 2000, p. 29.

⁵ See *Promoting International Co-operation*, Communiqué, International Energy Agency, Meeting of the Governing Board at Ministerial Level, 28-29 April 2003.

⁶ The projections presented by the IEA show that Russia's net oil exports would be lower than 270 Mt in 2010-2030, while some Russian oil majors predict that about 330-350 Mt could become available that would be surplus to domestic needs.

⁷ *World Energy Outlook 2002* (Paris: IEA/OECD, 2002), 118-119.

this share to 45% by 2020. The IEA also grossly underestimated Russia's potential to export natural gas to maritime markets in the Asia-Pacific region, including Japan, South Korea and the United States. In fact, the Sakhalin 2 LNG project could export about 12 Bcm of gas by 2015, or 50% more than the IEA outlook for 2030. Estimates for gas exports to China and the Korean Peninsula via pipelines are less dissimilar: 25 Bcm by 2030 proposed by the IEA and about 35 Bcm proposed by the *Energy Strategy 2020*.

Oil delivery infrastructure in Eastern Russia

The *Energy Strategy 2020* specifies that towards the end of the projected period, oil and natural gas exports to Asia should amount to one-third and one-sixth of the total cross-border supplies of these two hydrocarbons respectively. The plan includes building an oil pipeline linking the Yurubcheno-Tokhomscoe oil-and-gas field in Krasnoyarskiy Krai, and Talakanskoe and Verkhnechonskoye oil fields in Yakutia with the existing trunk oil pipeline that runs from Western Siberia to Angarsk, near Lake Baikal. Then, a mega-pipeline should be built in an easterly direction along existing railway routes. From Tynda, a larger pipeline would stretch along the Trans-Siberian railway to Nakhodka, while a smaller one would turn south, crossing China's border.⁸

This pipeline system designed by the Energy Ministry basically combines two separate projects. In 2000-2001, Yukos pushed for a 30 Mt capacity oil pipeline routed to China. A little later, Transneft proposed a 3,765 kilometer-long pipeline with a capacity of 50 Mt from Angarsk to Nakhodka, including a deep-water port and an oil terminal with a stockpiling facility of 4 million cubic meters.⁹ The estimated costs of these projects were close to \$3 billion and \$6 billion correspondingly. If it materialized, this integrated infrastructure could divert as much as 15-20% of Russia's total oil output and 25-30% of its entire exports to Asia-Pacific markets.

The management of Transneft reiterated that a larger pipeline to the Pacific coast would allow access to multiple markets in Northeast Asia and possibly North America. This pipeline would also allow the tapping of new oilfields in remote areas. Yet another argument in favor of the Angarsk-Nakhodka pipeline is its impact on regional development. Indeed, in 2002, the government re-adopted a modified program for the economic and social development of the Far Eastern region and the provinces adjacent to Lake Baikal. Given that the program's implementation

requires much more investment than the regional and federal budgets can provide, mega-projects such as the Angarsk-Nakhodka pipeline with a branch to Daqing would facilitate the mobilization of investment.¹⁰ Furthermore, the "northern route" proposed by Transneft could offer a way out of the environmental deadlock that the "southern route" creates due to the pipeline transiting Tunkinskiy National Park in Buriatia.

The integrated plan steered by the Energy Ministry also envisages building in parallel a high-capacity gas pipeline (about 33 Bcm), connecting the Kovykta gas field and a gas pipeline network in Western Siberia with the Pacific coast of Russia. This project, if implemented, will have a strong positive impact on regional development and the investment climate in Eastern Russia, facilitating the exploration and development of gas reserves in Eastern Siberia and Yakutia.

Oil prices

Prices for energy are likely to play a crucial role in defining the terms and conditions for existing and anticipated energy ties between Russia and Europe, as well as newly designed projects that should link Eastern Russia and Northeast Asia.

The *Energy Strategy 2020* specifies that, with international oil prices staying close to \$30 per barrel, Russia's energy exports could increase by 26-28% by 2010 and 36-38% by 2020. If prices stabilize in the range of \$18-20 per barrel, total energy exports are likely to rise by only 15-17% by 2010 and by 20-22% towards 2020, leveling off from 2005 onwards at 1990 physical volumes. Obviously, moderate energy prices would reduce the feasibility of such proposed mega-projects as Trans-Siberian oil and gas pipelines.

The prospects for a reduction in oil prices in the aftermath of regime change in Iraq have been actively debated. Various research centers and private sector companies generally agree that an increasing supply of oil would lower prices. However, experts tend to disagree on how significant this reduction might be. OPEC officials consider a level of \$25 per barrel to be reasonable, proposing to cut production quotas in order to avoid oversupply. On the other hand, the IEA has assumed that oil prices in 2020 will stay close to \$25 per barrel at 2000 values. These projections have been criticized as being unrealistically low and based on rather inflated estimates of OPEC's output capacity of 57.5 million barrels of oil a day (Mbd) by 2020. The argument is that OPEC's total maximum output cannot possibly exceed 40 Mbd.¹¹

⁸ In addition, ExxonMobil (Sakhalin-1) plans to build a pipeline with a capacity of 12.5 Mt from Sakhalin to the continent, across the Tatarskiy Strait. On the other hand, Sakhalin Energy (Sakhalin 2), a consortium led by Royal Dutch Shell, would build a north-south oil-and-gas pipeline system in Sakhalin.

⁹ Transneft holds a monopolistic position, covering oil supplies within the CIS and handling more than 95% of crude oil exports. It seems likely that, when Yukos initiated the dialogue on a pipeline project to China, Transneft felt that if private oil firms were to fund new pipelines, this could jeopardize not only its own role, but also the interests of the state, including control over the oil majors.

¹⁰ Reportedly, one million tons of additional oil production capacity from the new fields may require \$300 million of investment. If the 50 Mt capacity Transneft pipeline is eventually used only for oil supplied from new fields in Eastern Siberia and Yakutia, these areas will need about \$10 billion invested in exploration and development.

¹¹ Ali Morteza Samsam Bakhtiari "2002 to See Birth of New World Energy Order", *Oil & Gas Journal*, January 7, 2000, pp. 11-19.

On the other hand, some Russian oil experts have suggested that in the mid-term, \$21-23 per barrel is a fair price for Russian crude oil and that \$25-30 per barrel is too high, given that at this level, the production of alternative fuels as a substitute for oil would become feasible.¹² According to the U.S. Energy Information Administration, gas-to-liquid (GTL) technology could be an attractive marketing option at a certain price level for oil, because the infrastructure for petroleum products is already in place. GTL technology also has enough versatility to accommodate smaller gas deposits economically. In addition, GTL offers a number of environmental advantages that may enhance its economic attractiveness. However, it would require a long time and massive investment before a sizable GTL production capacity could not just complement oil, but constitute large segments of motor fuel supply.

According to some international oil majors such as ExxonMobil, in the last two decades, resource additions in both oil and natural gas have dramatically lagged behind increases in demand. Advanced new exploration methods have somewhat checked the decline in newly discovered reserves, albeit in areas with a challenging operating environment. Conditions that make oil and gas harder to recover will cause the prices of these resources to increase, with the lower boundary of the proposed price band nearing \$23-25 per barrel over the next two decades. However, the upper boundary reaches the \$50 mark, reflecting increasing demand for oil and gas accompanied by decreasing discovery volumes.

The point made by ExxonMobil¹³ is that, contrary to popular belief, for quite some time, the discovery of large volumes of oil and gas has not been related to price fluctuations, but was rather driven by the evolution of technology and geopolitical developments that have improved access to resources. In this context, the regime changes in Russia (1992) and Iraq (2003) serve as examples of "improved geo-political access", although in the case of Russia, it may take as long as 15-20 years for oil production to recover to its 1990 level. The good news is that the Russian oil sector is mainly privatized and oil companies could compete with OPEC suppliers at the lowest boundary of the projected price band.

Prospects for natural gas

Despite the rather upbeat projections for oil exports to the Asia-Pacific region (about 100 Mt in 2020) made in the *Energy Strategy 2020*, estimates for natural gas are quite conservative, reflecting various impediments and barriers to cross-border trade. There is no question that the energy-importing economies of Northeast Asia will significantly expand their reliance on natural gas. By 2020, demand for natural gas in Europe is due to grow by 2.7% a year, while in the Asia-Pacific region the increase in gas demand is expected to reach 4.5% a year.

There is a problem in that market access for pipeline

gas cannot be assured without adjustments to domestic policies in Japan, South Korea and China. In Japan, regional energy companies have enormous influence in determining the future of the power industry. If these companies, following global trends, reduce their emphasis on nuclear power, leveling off its current share in electricity generation, the market for natural gas will grow rapidly. Natural gas share in power generation could rise from the current level of 24% to 30% or more, which could justify the construction of a gas pipeline from Sakhalin to Sendai or Niigata, as is being proposed by ExxonMobil.

In South Korea also, official projections assume that nuclear and coal-fired plants will account for about 80% of total power generation beyond 2010, with "expensive" LNG remaining a marginal fuel. A gas pipeline from Sakhalin could allow the use of less expensive gas. On the other hand, given the current state of inter-Korean relations, an inland trans-Korea gas pipeline seems unlikely.

In China, the prioritization of the West-East pipeline over imports may have a negative impact on gas penetration. The west-east project is very expensive and the pipeline's capacity is comparatively low, if the transportation distance involved is taken into consideration. These factors would inevitably result in very high prices for natural gas, deterring customers. In addition, imported LNG will also be expensive compared with pipeline gas that could be imported from Russia or Central Asia. Both these factors are likely to hold back the development of the gas market, potentially curbing gas demand and opportunities for cross-border pipeline projects.

The predominant reliance of Japan and South Korea on LNG creates a barrier to most of the Russian natural gas that could be supplied from the heartland of Eastern Siberia and Yakutia via pipelines. By 2020, the global demand for LNG (excluding U.S.) is expected to quadruple, while the share of LNG in gas consumption will increase from the current 10% to 25%. A number of new technological trends and innovative marketing concepts could further enhance the advantages of LNG in the context of Northeast Asia.

Given these circumstances, Russia need not rely on pipeline projects alone, as it does in Europe. Potential independent gas producers should seriously consider LNG in combination with pipeline projects - goals that the *Energy Strategy 2020* does not formulate. In this regard, the recently announced blueprint for natural gas transportation schemes in Eastern Russia, including two LNG terminals to be located in the vicinity of Vladivostok and Vanino and connected with both Sakhalin gas reserves and East Siberian gas reserves, could be a step in right direction.¹⁴ Furthermore, advanced GTL technologies could help moderate the region's high dependence on oil, using competitive sources of natural gas.

Gas prices

On the other hand, the authors of this document provide for major adjustments in natural gas pricing in

¹² Interview with Mikhail Khodorkovskiy, *Itogi*, December 17, 2002.

¹³ Harry J. Longwell, Executive Vice President, ExxonMobil, Remarks at the Offshore Technology Conference, Houston, May 7, 2002.

¹⁴ See Alexey B. Miller, op. cit., Figure 5. Gas of the Russian East.

Russia. Currently, low domestic gas prices (0.62 of the level for coal) make Gazprom's revenues and investment programs almost entirely dependent on exports. This situation will change with increased gas prices (1.1 of the level for coal by 2006), improving further from 2010-2020.

By 2006, domestic gas tariffs adjusted for inflation should double compared with 2002 levels, while by 2010, the domestic price is expected to be balanced by European gas market prices adjusted for transit fees, import tariffs and other duties. As a result, gas prices will be triple the current level by 2010.¹⁵

Changes in gas pricing would obviously affect prices for electricity and coal, which are expected to grow by half by 2006, doubling by around 2010. At the same time, the competitiveness of coal will increase, leading to a decrease in the share of natural gas in the total primary energy supply from the current 50% to 48% by 2010 and 45% by 2020. By 2010, the share of coal in the total energy supply is projected to grow from the current 19% to 20%, with the share of nuclear power rising from 11% to 12%, replacing natural gas.

Increased gas prices would enlarge the proceeds from domestic sales, making gas exports less attractive. On the other hand, gas market reform and liberalization promise to make investment in new natural gas ventures more feasible.

Canada as a model

The *Energy Strategy 2020* envisages natural gas production in Eastern Siberia and the Far Eastern region climbing to 100 Bcm under favorable conditions. However, it does not offer a detailed concept for reserve development, infrastructure construction and gasification in these areas. As mentioned above, the Energy Ministry and Gazprom¹⁶ proposed building a Trans-Siberian high-capacity gas pipeline, connecting the Kovyktinskoe and Chayandinskoye gas fields and other gas fields in Eastern Siberia and Yakutia in parallel with the Trans-Siberian oil pipeline.

Indeed, the largest cities in Eastern Russia are located along the Trans-Siberian railway. The total population of these cities is more than 4 million and at least another 4-5 million people live in smaller settlements located along the border with China. In addition, the same railway zone is a prime location for major industrial enterprises and power plants.

This plan for gas transportation includes an extension of the pipeline from Vladivostok to the Korean Peninsula. However, it seems that the "Canadian pipeline model" could be more realistic in policy terms and more fundable in terms of the project's implementation. Indeed, there are some similarities between Eastern Russia and Canada, with its "gas production in the west, consumption in the east" pattern.

In Canada, the single West-East transmission pipeline system moves gas across the country and along the U.S.

border. Although there is considerable domestic consumption of gas, the 16 export pipelines deliver gas to U.S. markets. These pipelines are spread out along the border and their total annual maximum capacity is above 80 Bcm.¹⁷ Canadian gas infrastructure allows the number of users to be maximized with a number of export-oriented branch pipelines tailored to market needs. A similar approach adopted in Eastern Russia would serve to integrate the domestic use of natural gas with its export to neighboring cities in northeastern China.

Power generation: Nuclear and coal

The *Energy Strategy 2020* proposes the interconnection of power grids in Eastern Russia between Western and Eastern Siberia and the Far Eastern region. The Federal Grid Company and the System Operator, both funded from federal sources and controlled by the state, will be the major players in the national grid's maintenance, expansion and management. Electricity prices are projected to double by 2020, reaching 4.0-4.5 cents per kWh as the average tariff for all groups of customers.

Cross-border interconnection is also on the agenda, with optimistic forecasts of electricity exports reaching 75 TWh by 2020. European electricity markets and power grid interconnection are defined as the priority goals.

The *Energy Strategy 2020* envisages the construction of new power plants, including coal-fired and hydroelectric power plants built in Eastern Siberia and hydroelectric, gas-fired and nuclear power plants constructed in the Far Eastern region. In total, the share of nuclear power in power generation should rise from the current 16% to 23% by 2020 (32% in Western Russia). These power plants will be under the control of a unified state company and their competitiveness vis-à-vis thermo-power plants will be significant (2.4 cents per kWh in 2015).

Yet another major priority for power generation is a very significant increase in coal production. Inter-regional transportation of coal from production sites in eastern regions to consumption centers in western areas would double coal shipments to 130 Mt a year by 2020.

By 2020, both Eastern Siberia and the Far Eastern region should see the expansion of coal output to 40-50 Mt in each area, including 75-80% produced from open cast projects. Reduced production costs and improved quality of coal could potentially expand export prospects for Russian coal in Japan and South Korea. New generation coal mining equipment would allow the setting up of production cooperation schemes involving foreign manufacturers.

Hydroelectricity

As of today, despite the critical significance of oil and natural gas, the most advantageous area for cross-border energy cooperation appears to be hydroelectric power. Electric power is now the only exportable energy resource in Eastern Siberia. The regional electric power systems in

¹⁵ Domestic gas prices, projected to rise from the current \$23 per 1,000 cubic meters (Kcm) to \$40-41/Kcm in 2006, \$40-45/Kcm in 2008, \$59-64/Kcm in 2010 and \$60-65/Kcm towards 2020.

¹⁶ See Alexey B. Miller, op. cit., Figure 5. Gas of the Russian East.

¹⁷ *Natural Gas Pricing in Competitive Markets* (Paris: OECD/IEA, 1998), 64; *Energy in Canada 2000*, 60, available at www.nrcan.gc.ca/ec

Krasnoyarskiy Krai and Irkutskaya Oblast have excess capacity, capable of producing about 16-18 billion kWh (TWh) of electricity. Annual power generation by all Far Eastern hydroelectric power plants is 11 TWh. After the completion of four new projects, power output will grow to a combined total of 23 TWh a year.

Eastern Russia's unique hydroelectric power potential presents an opportunity for projects that are efficient both in economic and environmental terms. Moreover, the gradual deregulation of natural gas tariffs in Russia is likely to make hydroelectric power more competitive in the future. By 2010, the total newly commissioned capacity in both areas is likely to reach 4 GW, including 1.5 GW in Eastern Siberia and 2.5 GW in the Far Eastern region. During the following decade, new capacity is expected to total just 2.2 GW, including 1.4 GW in Eastern Siberia. After the completion of these projects, the hydroelectric power utilization rate in the Far Eastern region will be 6%.

The potential for electric power exports will be further enhanced with the commissioning of the Bureyskaya HPP, the top priority for the Far Eastern region. Its commissioning will reduce the demand for coal from distant sources and allow electricity exports to China and the Koreans. By 2020, if adequate investment is secured, the seven hydroelectric power projects currently under construction and those at the planning stage will generate up to 50 TWh of electricity at competitive prices. In the optimistic scenario, electricity exports from the eastern regions of Russia to neighboring countries may be estimated at 20-22 TWh by 2010 and 50-60 TWh by 2020. The Chinese market could provide an opportunity for electricity exports of about 15-25 TWh a year from Irkutskaya Oblast alone.

However, as of today, there are only 110 kV and 220 kV power lines extending to Mongolia and Northeastern China, and these have a limited transmission capacity. Discussions are underway concerning the formation of cross-border electric power network infrastructure, with Russia playing the role of the electricity supplier. This is not an easy task, considering the distances and costs involved, not to mention access to neighboring markets. The practical steps proposed by electricity experts include a 2,600 kilometer-long 600 kV "Bratsk-Beijing" 3GW (18 TWh) capacity line, and a 470 kilometer-long 600 kV "Sakhalin-Japan" 4GW (22 TWh) capacity line.

Investment requirements

The energy sector development outline for Eastern Russia contains significant potential for investment, including new business opportunities for companies and investors from Japan, South Korea, the U.S. and China.

More generally, the development of energy industries in Russia is seen in the context of technological advancement and hi-tech research and development efforts that will reduce project costs and enhance energy efficiency. For example, a new hi-tech phase in generation could be based on superconductivity, cryogen technology applications in power generation and transmission, fast-breeder reactor technology, tidal power generation and hydrogen energy.

To sustain domestic demand, expand exports and

modernize domestic energy industries, Russia needs at least \$620 billion of investment over the next two decades, including \$260-300 billion mobilized before 2010-2012. Most of these funds should originate from private sources and loans. This investment program should support energy infrastructure development, including the construction of new power plants and the modernization of existing facilities, as well as a broader re-orientation of the energy sector towards increased efficiency and added value. In 2001, the total amount of investment in the energy sector from all sources is projected to reach \$660-810 billion (Table 2).

Table 2. **Estimated Investment Requirements, 2002-2020 (US\$ billion)**

	2001-2010	2011-2020
Oil	230-240	
Natural gas (continental projects)	170-200	
Coal	20	
Heat production and use	70	
Power generation, including	130-170	
Power generation	110-140	
Power grids	20-30	
Nuclear power		
Energy saving programs	50-70	
Total	260-300	400-510

Source: Ministry of Energy

It should be noted that these figures are not astronomical in the context of worldwide energy industry needs. According to private energy companies, if world output grows by 3% a year, with energy demand increasing by 2% annually and the recovery of energy resources from existing fields dropping by 4-6% a year, by 2010 about half of oil and gas consumption will have to rely on newly developed reserves. Most of these new reserves are located offshore, in deep-sea areas and/or in Arctic latitudes, in locations distant from consumption centers. The increasing complexity of recovery requires advanced technologies and huge start-up investment, estimated at about \$1 trillion for the current decade alone. For example, the investment program of ExxonMobil up to 2010 is estimated to total \$100 billion.

Conclusions

In one way or another, these investments are likely to be mobilized, considering that oil reserves in Russia are estimated at 17,000-20,000 million tons (Mt), allowing production of 450-500 Mt of oil a year for another 30 years. Proven reserves of natural gas would allow annual gas production to be sustained at 600-700 billion cubic meters (Bcm) for at least the next 50 years. Gazprom alone controls 20% of world gas reserves, accounting for 23% of world gas production.

Only the Sakhalin 1 and Sakhalin 2 international consortiums, in which Japanese companies are involved, plan to invest as much as \$25 billion over the next decade or so, but several other oil and gas projects on the Sakhalin shelf are in the formation phase, promising to generate another \$30 billion to \$50 billion in investment.

British Petroleum works closely with the state-owned Rosneft in exploring prospects for investing in the Sakhalin 5 and Sakhalin 4 projects. Also, BP recently decided to invest almost \$7 billion in a new company formed with TNK, the Russian oil major with a presence in Eastern Siberia. In this context, an oil pipeline project to Nakhodka that the Japanese Bank for International Cooperation could partially back with its low-interest loans looks like a reasonably priced venture.

All these investment funds that should support energy infrastructure development in Russia would potentially create huge business opportunities for Japan and Russia's other neighbors. Investors and equipment manufacturers could benefit from the construction of new power plants and the modernization of existing facilities, as well as a broader reorientation of the Russian energy sector toward increased efficiency and added value.

More generally, the development of energy industries is seen by the Russian government in the context of technological advancement and high-tech research and development that would reduce project costs and enhance

energy efficiency. Japan-Russia technological cooperation in the field of energy, fuels and emission reduction could benefit both countries.

In addition, cross-border power interconnection is on the Russian long-term agenda, with forecasts of electricity exports to China and the Koreas. European electricity markets and power grid interconnection have been already defined as the priority goals. Eastern Russia's unique hydroelectric power potential presents an opportunity for projects that are efficient both in economic and environmental terms. It seems that the proposed plan for energy sector development contains significant potential for investment and trade, including new business opportunities for companies and investors from Japan, South Korea, the United States and China. On the other hand, cross-border energy cooperation in Northeast Asia, focused on energy sector development in Eastern Russia, would enhance the energy security of the economies of this area, contributing to their international competitiveness and the political stability of the entire Asia-Pacific region.