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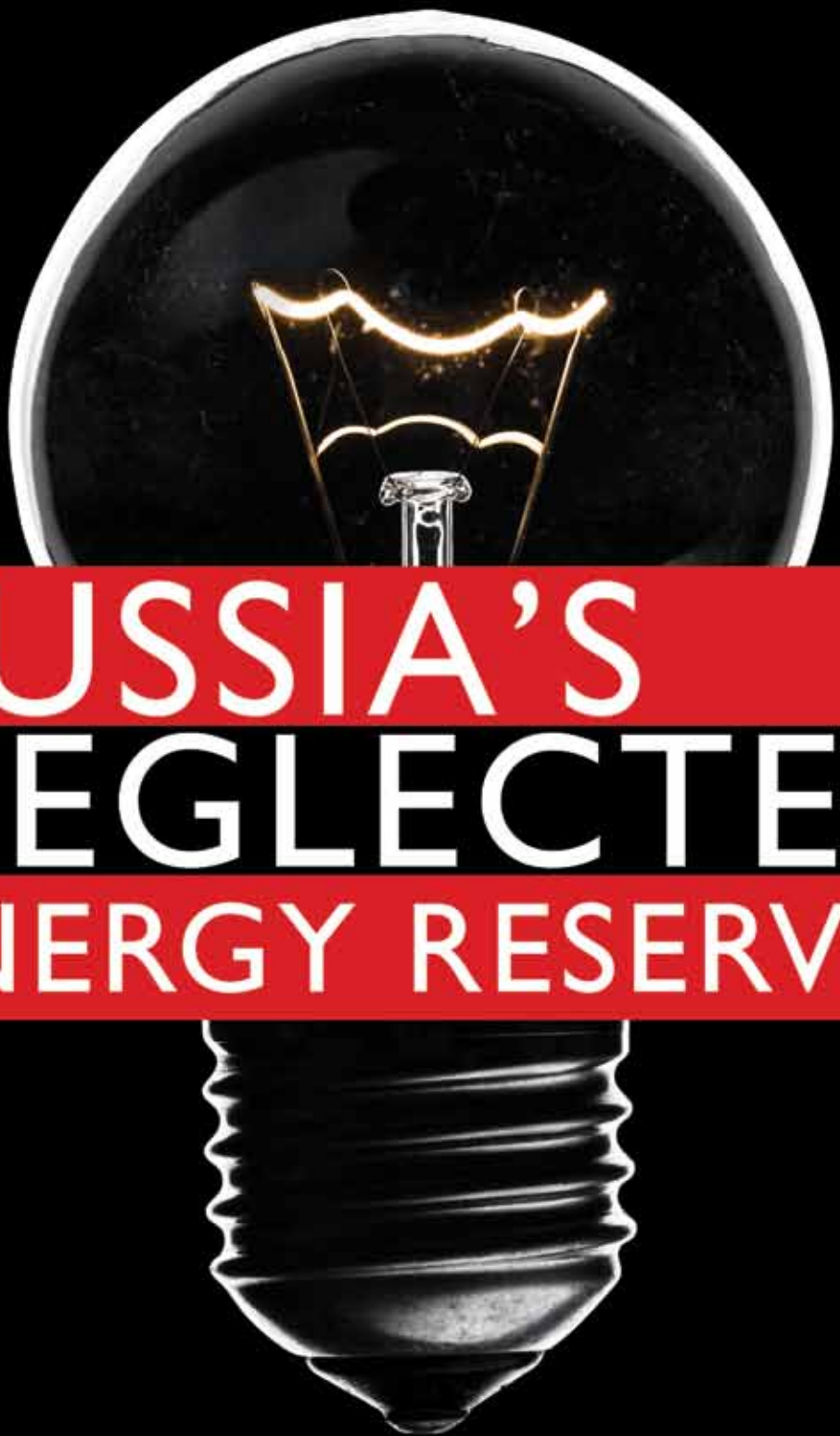

RUSSIA'S NEGLECTED ENERGY RESERVES

CARNEGIE ENDOWMENT
FOR INTERNATIONAL PEACE
WASHINGTON DC ▪ MOSCOW ▪ BEIJING ▪ BEIRUT ▪ BRUSSELS

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Excerpts From President Dmitry Medvedev's Comments
State Council Presidium Meeting
Arkhangelsk, July 2, 2009

"Energy efficiency is a topical and a cumbersome issue, so addressing every aspect of it is very urgent, as we seem to be falling behind in every respect....

"I think that to a certain extent, we are falling behind not only because of the difficulties we faced in the 1990s and even earlier, but also because of our mindset, because we have never tried to save energy. We always believed that we were entirely self-sustaining when it came to energy....

"Losses within the heating supply system can go as high as 60 percent, and in reality, they may be even higher. Electric power lines are absolutely outdated and coupled with the outdated illumination devices they cause immense energy waste....

"Ultimately, inefficient energy consumption is damaging for municipal and regional budgets and brings about extra costs for the people. Furthermore, the social compensations that we pay to the households have to be borne by budgets at all levels. Thus, we should openly recognize that housing and utilities are our most expensive and ineffective sector in terms of energy....

"We are observing the way that other countries are developing in energy. As you know, some places have special buildings that do not use any external energy, where energy consumption matches energy generation. It should be in the interest of any property owner to rebuild his or her property to ensure efficient energy saving, or to design and build new property on an entirely different technological foundation....

"But for now, our property owners either cannot or do not want to do this. Energy efficiency first appeared on the agenda shortly before the crisis. But now, with lack of funds, many have halted these improvements. Still, I think that it may well serve our goals if government anti-crisis assistance to the industries and manufacturers is conditioned by submission of a specific plan for reducing energy consumption. Otherwise, we will simply continue to foster bad energy management."

SUMMARY

Russia has the world's largest share of fossil energy resources. During the Soviet era, because this wealth of resources insulated the country from global energy crises, citizens never had to worry about conserving energy, and much was squandered. Since the collapse of the Soviet Union, the situation has improved in western, urban Russia, but great expanses of this vast country continue their inefficient ways. Indeed, recognizing that minimizing waste helps preserve Russia's resources, Russian President Dmitry Medvedev successfully urged the Duma to pass sweeping new energy-efficiency legislation. But more remains to be done to identify how energy resources are used and wasted, and where efficiency might be improved.

This report identifies how much-needed efficiency could be implemented in five key areas by:

1. Modernizing an aging electric power system with new and upgraded power plants and major reductions in transmission and distribution losses.

2. Upgrading and replacing the nearly 17,000 Soviet-era district heating systems.

3. Reducing the energy intensity of Russia's industry, which is far higher than in competing countries.

4. Retrofitting a porous housing and building stock and introducing an energy-efficiency building code.

5. Applying the brakes to a runaway acceleration in the energy used in transportation through efficiency standards for vehicles and improved mass transit.

Achieving these changes will require effective federal-district-local programs, financing, human resources, and time. There are significant payoffs: a more competitive economy, new jobs, and increased national income from exports of saved natural gas and oil. Russian leaders may or may not be motivated by climate change concerns, but these energy-efficiency reforms will earn their country greenhouse gas emission reduction credits—another benefit from better management of their rich natural resources.

INTRODUCTION

It is true that we are the world's leading nation in terms of energy resources. This does not mean, however, that we may irresponsibly consume such resources.

Russian President Dmitry Medvedev
Speaking at the State Council's Presidium
Arkhangelsk, July 2, 2009

Russia is known for its energy resources: the world's largest natural gas reserves, second largest coal reserves (behind the United States), and eighth largest oil reserves.

Russia also has the world's largest reserve of energy that could be saved through available, cost-effective energy-efficiency measures—a fact that until recently has gone relatively unnoticed.

The recognition of this reserve led Medvedev to convene the Presidium meeting in Arkhangelsk on "Improving the Energy Efficiency of the Russian Economy," where he pressed the assembled governors to focus more on wasting less energy.

> We must improve energy saving in every area, but I would like to particularly single out the situation in the public utilities sector. All of the governors here today are well aware that energy is used in an atrociously inefficient way when it comes to the heating and public utilities. Our buildings and our overall housing infrastructure are a kind of black hole that sucks in enormous amounts of energy resources.[1]

Medvedev told the governors he was asking the State Duma to approve a law "on energy conservation and increase of energy efficiency." The Duma did so, and the far-reaching law came into force on November 27, 2009. It establishes sweeping principles of energy efficiency covering

appliances, lighting, housing, utilities, energy meters, contracting, financing, and information. (See "Russia's Energy Matryoshka" box.) The challenge is implementing and enforcing those principles.

Russia's energy issues are inextricably linked to its climate change policies. Russia and India are the third and fourth largest producers of greenhouse gas (GHG) emissions. (Which places third depends on how one calculates emissions.)[2]

At the December 2009 Copenhagen meeting, Russia stayed largely on the sidelines as nations struggled to agree on a successor to the Kyoto Protocol. Russia has a unique win-win opportunity if it acts aggressively to couple its energy and climate-change policies. Russia's energy intensity—how much energy it uses to produce a unit of gross domestic product (GDP)—is higher than that of other major countries, illustrating its slow industrial modernization. Russia is second only to Iran in the cost of its energy subsidies; using energy more efficiently would lower government costs. The saved natural gas—the bulk of the savings—could be exported to meet national commitments, raise funds for modernization, and create needed jobs nationwide. The elimination of energy waste also would reduce GHG emissions, earn marketable emission reduction credits, and place Russia among climate-change-conscious nations.

Russia's Energy Matryoshka
Energy Efficiency Legislation, 2009

The Energy Efficiency legislation that came into force November 27, 2009, is as revealing as Russia's famous matryoshka (nesting dolls). The first appearance is remarkable. The legislation includes layer after layer of major energy-saving measures that have taken years to enact in other countries. The layers include:

- Energy performance labels. Manufacturers and importers must label the energy performance of certain types of goods based on principles to be adopted by the Russian government. The provisions are to take effect for household appliances by January 2011, and for computers and office equipment a year later.
- On January 1, 2011, incandescent light bulbs will be banned in state and municipal buildings and incandescent light bulbs over 100W will be banned throughout Russia. On January 1, 2013, light bulbs over 75W will be banned, and on January 1, 2014, bulbs over 25W will be banned.
- New buildings and facilities must meet energy-efficiency standards, which will be revised at least every five years. A Russian state authority will draft rules for implementing the standards.
- The Russian state authority will develop energy-efficiency standards for apartment buildings, which must be shown on the façade of new buildings.
- Meters are to be installed to measure natural gas, electricity, heat, and water at all buildings but apartment buildings by January 1, 2011; apartments have until January 1, 2012. Audits are required to identify the energy-saving measures in the common areas of apartment buildings.
- Energy audits are promoted and required for some facilities. Only self-regulatory organizations are authorized to conduct energy audits. They are mandatory for energy companies, large energy consumers, and "regulated activities"; the initial audits must occur by December 31, 2012, and then every five years.
- To facilitate these changes, "energy service contracts" are to be introduced where the cost of the improvements is paid from the resulting energy savings.
- State and municipal governments and energy suppliers are required to develop energy-saving programs for their customers.
- Governments at all levels are to practice energy saving in their procurements.
- State programs are expected to set targets for the use of renewable energy sources and secondary energy sources, such as cogeneration.
- The legislation expands the use of investment tax credits and accelerated depreciation to stimulate investment in energy efficiency, with the terms to be set by the Russian government.
- A national energy-saving information and education plan is to be initiated. Energy suppliers are required to inform their customers of energy-saving measures. Companies are to report their energy expenses in their annual financial statements.

Despite the breadth and level of detail in the legislation, it has been received with some skepticism. It supersedes a 1996 Russian law "On Saving Energy," which called for massive improvements in energy savings but was primarily declarative. It was largely ignored.

There are signs the new legislation should be taken more seriously. It is filled with tight deadlines, supporting amendments in the tax code, and instructions to relevant federal ministries. Medvedev's outspoken support for energy efficiency should have an impact.

However, the final face of Russia's energy matryoshka remains a mystery. The motives and effort behind the legislation are noteworthy. The goals are ambitious and on target. But passing energy-efficiency legislation—as difficult as that might be—is often the easy part. The hard part is implementing it effectively.

BACKGROUND

To understand Russia's challenges and opportunities, it is important to understand how the country reached this point: the attitude toward energy as the USSR, the progress since the Soviet era, and the problems and barriers of its current situation.

Energy conservation efforts began in most developed countries in the 1970s following the 1973–1974 OPEC oil embargo. But the Soviet Union and other centrally planned economies avoided many of the severe impacts of the embargo because Russia's ample energy resources softened the impact of the international shortages and rising prices.

After the Soviet Union collapsed, Russia, the former Soviet republics, and Eastern European countries found their separate ways into the supply-and-demand realities of the global energy market. The response has varied. Leading the charge are the Baltic states, Belarus, Bulgaria, Kazakhstan, and Kyrgyzstan, which have reduced their energy intensity 5 percent to 8 percent annually for the past fifteen years. Russia has slipped behind, decreasing its intensity 3.4 percent annually, followed by Ukraine at 2.7 percent and Tajikistan at 1.8 percent.[3]

Russia's slide can be blamed on its abundant energy resources, which fed an attitude of immunity from global energy worries. While its size and harsh climate have contributed to its energy use, its diffuse political infrastructure has delayed recognition of energy efficiency as a priority. As a result, its energy intensity is double that of most of the top-ten energy-consuming countries. (See "Energy Intensity of the Top Ten Energy-consuming Countries" table.)

Table 1.
Energy Intensity of the Top Ten Energy-consuming Countries

Country	Total energy consumption (million toe*)[4]	Energy intensity kgoe** per GDP (PPP)
United States	2,340.29	0.19
People's Republic of China	1,717.15	0.20
Russia	646.68	0.42
India	537.31	0.14
Japan	530.46	0.14
Germany	344.75	0.14
France	275.97	0.14
Canada	271.95	0.25
United Kingdom	233.93	0.12
Korea	213.77	0.20

* tons of oil equivalent ** kilograms of oil equivalent

Source: Table 3.1 of the World Bank Group report, "Energy Efficiency in Russia: Untapped Reserves," 2008. Energy consumption data from the International Energy Agency (IEA) Energy Balances data set, 2005. GDP data from the World Bank Development Indicators Database.

Russia has a huge opportunity to reduce its energy costs and lower its energy consumption. It could lower its consumption of natural gas and, in turn, increase its exports of natural gas and the flow of rubles back to Russia.

Progress has been slow, but that's not because of a lack of effort by senior leaders in Russia and abroad. In the United States, scientists and engineers began collaborating on energy issues in the mid-1970s, before the collapse of the Soviet Union. (See "U.S.–Russian Collaboration on Energy Efficiency and Climate Change" box.) The World Bank and European Bank for Reconstruction and Development (EBRD) have funded important studies and projects, and the International Energy Agency has encouraged participation in its policy and research collaborations. Private companies have been drawn to the opportunities to develop and efficiently use Russia's energy riches.

The results in western Russia are impressive: In many areas of Moscow, St. Petersburg, and scattered economic and industrial zones, demonstrations and pilot projects have produced cost-effective energy

U.S.–Russian Collaboration on Energy Efficiency and Climate Change

The U.S.–Russian collaboration began during the Cold War. In 1983 Russian academician Evgenie P. Velikhow, senior vice president of the Soviet Academy of Sciences, visited Princeton University's Center for Energy and Environmental Studies. Princeton scientists Robert Socolow and Robert Williams recognized that the stifled communications between the United States and the USSR had blinded both sides to the other's energy-technology advances.

With support from the Soviet Academy of Sciences, the U.S. National Academy of Sciences, and foundations, they organized a weeklong meeting of energy conservation specialists in Moscow in June 1985. The results, published in a special report of *Energy—The International Journal*, consisted of 24 articles by Soviet, U.S., and Swedish authors or co-authors and initiated ongoing cooperation on a broad range of energy technology and policy issues.[5]

During the 1990s, Russia became a showcase for two of the most effective U.S. international development programs: the creation of a network of foreign Energy Efficiency Centers in targeted countries and the climate change Country Studies Program. In both, the bulk of U.S. funding was provided to the targeted countries to develop their in-country program-delivery competence, rather than being siphoned off to intermediary contractors.

Under the first, the Russian Center for Energy Efficiency (CENEf) was created in 1992. CENEf Director Igor Bashmakov led the team that prepared the World Bank Group's study, "Energy Efficiency in Russia: Untapped Reserves," which was quoted widely in this paper. CENEf was founded by the U.S. Agency for International Development (USAID), the U.S. Department of Energy's Pacific Northwest National Laboratory, the World Wildlife Fund, and the International Social and Ecological Union (Russia). CENEf survived during the difficult 1990s and has earned respect for its energy-efficiency and climate-change leadership.

The second example, the U.S. Country Study Program,[6] is a reminder that until the 1997 adoption of the Kyoto Protocol, the United States was a leader of the international climate change field. The program provided financial and technical assistance to 56 developing and transition countries, helping them create climate-change plans and the capacity for an ongoing role on climate issues. The bulk of the funds went to the countries to inventory their GHG emissions, identify mitigation measures, assess their vulnerability, and adapt to changes. In the mid-1990s the program supported a strong team of Russian scientists in the Federal Service for Hydrometeorology and Environmental Monitoring (RosHydroMet). Team members continue to have key roles in Russia's climate-change program. Dr. Yuri Izrael, who led the study, was a vice-chairman of the Intergovernmental Panel on Climate Change. Dr. Alexey Kokorin, a leading author of the study, joined the World Wildlife Federation (WWF) Russian office in 2000, where he continues to be an effective champion for climate change action.

A companion climate change program, the U.S. Initiative on Joint Implementation (USIJI), supported the development of voluntary programs between U.S. and non-U.S. partners that created plans to reduce, avoid, or sequester GHG emissions. Between 1993 and 2001, the USIJI accepted 52 projects out of the more than 200 submitted. The program demonstrated the cost-effectiveness of bilateral projects and helped shape the Joint Implementation and Clean Development Measure programs in the Kyoto Protocol. Six of the JI pilot projects were in Russia: district heating renovation in Lytkarino; improving district heating efficiency in the Metallurguichesky District of Cheliabinsk; reforestation in Vologda; RUSAFOR-Saratov afforestation project; RUSAGAS: Fugitive gas capture project; and Zelenograd district heating system improvements. *(continued on next page)*

savings in factories, new and renovated housing, hospitals, and district heating systems. However, little has changed in the bulk of the hinterland. A fundamental, nationwide transformation of attitudes, priorities, and financing is essential to Russia's health and prosperity.

A 2008 World Bank Group report, "Energy Efficiency in Russia: Untapped Reserves," does an outstanding job of describing Russia's opportunities and obstacles and offering solutions. The report was prepared for the World Bank Group by the Center for Energy Efficiency (CENEf) in Moscow, a nongovernmental organization. Its director, Igor Bashmakov, has been an outspoken champion of energy efficiency since CENEf was founded in 1992.

U.S.–Russian Collaboration on Energy Efficiency and Climate Change (continued)

The U.S.–Russian collaboration has extended to many other leaders and organizations. Examples include:

- Prof. Yuri Tabunschikov, president of ABOK (Russian Association of Engineering for Heating, Ventilation, Air-Conditioning, Heat Supply and Building Thermal Physics). ABOK is an associate member of ASHRAE, the leading U.S. engineering organization that writes building energy and environmental standards. Tabunschikov has been honored as an ASHRAE fellow. The ABOK website (www.abok.ru) is a rich source of energy-efficiency material, much of it available in English.
- Marianna Brodach, a leading ABOK architect.
- Dr. Yuri Matrosov[7] at the Russian Research Institute of Building Physics (NIIHS) in Moscow, who was ahead of his time in the early 1990s with the idea of "building passports" to track and optimize the performance of buildings through changes in use and introduction of advanced technologies. Matrosov speaks frequently in the United States and recently summarized the results of two decades of research and development in a Russian book: *Energy Conservation in Buildings: Problems and the Ways to Solve Them*.

These and other activities have received support from U.S. and international sources including the U.S. Agency for International Development, Department of Energy, Environmental Protection Agency, the World Bank, United Nations Environment Program, International Finance Corporation, Global Environment Facility of the United Nations Development Program, European Bank for Reconstruction and Development, United Nations Economic Commission for Europe, The John D. and Catherine T. MacArthur Foundation, Alliance to Save Energy, Natural Resources Defense Council, and International Institute for Energy Conservation.

ENERGY SAVINGS POTENTIAL

The World Bank report concluded that Russia could save 45 percent of its total primary energy consumption through energy-efficiency actions. The energy-saving measures would cost $320 billion and result in cost savings to investors and end-users of $80 billion a year for a four-year payback period. The benefits could be higher—$120 billion to $150 billion a year—if the potential annual earnings from increased natural gas exports were included.[8]

The savings would include:

- 240 billion cubic meters of natural gas;
- 340 billion kilowatt hours (kWh) of electricity;
- 89 million tons of coal; and
- 43 million tons of crude oil and refined petroleum products.

The benefits would be large and widespread:

- Lower energy costs would send rippling financial benefits to households and commercial, public, and industrial operations nationwide.

- The transformation would create jobs throughout Russia, particularly in regions with high unemployment, such as rural areas. Providing reliable energy services would enhance the country's long-term economic prospects.

- The reductions in GHG emissions would enable Russia to meet even the most stringent commitments being considered in a successor to the Kyoto Protocol.

- Assistance could be targeted for the neediest, reducing the increasing hardships of Russia's low-income families.

- The saved natural gas and petroleum would be available for export, adding to Russia's international trade earnings.

ENERGY EFFICIENCY CHALLENGES

The potential savings are there, but capturing them will be difficult. Success will require a sustained commitment at all levels of government that addresses Russia's tangle of political, economic, and social issues, particularly in the wide reaches of the country.

Russia first must clarify its energy priorities. Does it want to use its abundant natural gas resources to coerce other countries to support its political policies, or does it want to play by international energy rules and attract international collaboration and financing to develop its energy supply and energy-efficiency reserves?

This question received additional attention last fall when Russia terminated its long-standing intent to ratify the Energy Charter Treaty (ECT). The treaty was signed in 1994, at the end of the Cold War, when nations thought energy offered unprecedented opportunities for mutually beneficial cooperation. To ensure a level playing field between energy exporters and importers, the ECT established rules on the exploration, development, and acquisition of resources, making them publicly available, nondiscriminatory, and transparent. Disputes are resolved amicably or by arbitration.

Russia was seen as playing a pivotal role in the formation of the ECT; in fact, the ECT website is in English and Russian.[9] The treaty has been signed by 51 nations, the European Community, and Euratom. Russia signed the treaty in 1994, but has never ratified it; the country accepted the provisional application of the treaty, pending ratification, and played by the ECT rules for fifteen years. Yet Russia announced on August 20, 2009, that it did not intend to ratify the ECT, freeing it from any future treaty obligations 60 days later on October 19.

In the early years of the ECT, common energy challenges often fostered cooperation among member countries. In recent years, power politics has made some issues contentious. Russia forcefully reorganized Yukos, its largest energy company, pressuring Shell and BP to sell their investments at below-market prices. The case was headed to arbitration, as required

under the ECT. Some observers think Russia withdrew from the ECT because it fears a negative ruling.

Russia's loss of an energy relationship based on international commercial rules will not only affect supply-side agreements, but also will affect the introduction and financing of foreign investments in energy efficiency and renewable energy advances that are essential for a modern economy.

David Clark, chair of the Russia Foundation, noted this downside risk in a column in the *Financial Times*.[10]

> After Russia's rejection of the guarantees contained in the ECT, investors may now follow suit and look for less risky options for a return on their capital. If so, Russia's potential as an energy superpower will remain unrealized and it will pay a heavy economic penalty in lost revenues and flagging growth.

The rejection of the ECT complicates the daunting challenges Russia faces if it is to catch up with other countries' energy-efficiency performance. (For additional information, see "Downside of the Energy Superpower Strategy" box.)

Table 2.

Fuel and Energy Balance for Russia[1] (Million tonnes of oil equivalents)

	Coal	Crude oil	Petroleum products	Natural gas	Other solid fuels	Nuclear	Renew-ables	Electricity	Heat	Total
Production	134.97	470.14	–	517.13	14.36	39.72	15.05	–	–	1191.37
Import	11.05	2.38	0.28	6.22	–	–	–	0.87	–	20.80
Export	-39.23	-252.59	-97.10	-167.27	–	–	–	-1.94	–	-558.13
Stock changes	-1.26	0.07	0.77		–	–	–	–	–	-0.42
Total Primary Energy Supply	105.52	220.00	-96.05	356.08	14.36	39.72	15.05	-1.06	–	653.62
Electricity[2]	-34.19	–	-3.73	-91.60	-3.35	-38.82	-15.05	81.98	–	-104.77
Heat generation[3]	-41.25	-0.79	-12.48	-129.40	-6.26	-0.90	–	-3.52	161.63	-32.97
Fuel processing[4]	-3.37	-211.80	200.49	-17.80	-0.42	–	–	-19.79	-32.53	-85.21
Total Final Energy Consumption[5]	26.06	0.11	61.97	96.87	4.01	–	–	57.52[6]	130.11	376.65
Industry[7]	22.85	0.08	7.69	24.93	2.95	–	–	21.72	44.44	124.68
Building sector[8]	3.03	–	1.45	38.78	1.04	–	–	20.37	84.24	148.91
Transportation[9]	0.21	–	52.76	33.16	0.01	–	–	6.82	1.44	94.40
Non-energy use	0.65	0.20	26.15	18.41	0.32	–	–	–		45.73

1 The information in this table is obtained from Table B.1: Integrated Fuel and Energy Balance for Russia, in the World Bank report, pp. 125–126. To simplify the table, the rows of data have been aggregated, as summarized in the footnotes. (Small computational inconsistencies are due to different statistical sources and rounding.)

2 Includes fossil fuel electricity plants, combined heat and power, diesel power, nuclear and renewable plants.

3 Includes fossil fuel electricity plants, combined heat and power plants, diesel power, industrial boilers, small boilers, and secondary heat units.

4 Includes coal and peat production and transformation, oil production, oil refinery, gas production and processing, own use, and distribution losses.

5 The non-energy use has been subtracted from the TFEC in this table. The table in Appendix B includes the non-energy use under the TFEC.

6 In Table B.1 in the World Bank report, the sectoral breakdown of electricity consumption totals 48.91 mtoe, which is less than the TFEC number in the report.

7 Includes manufacturing, agriculture and forestry, fishing and mining, and construction.

8 Includes residential, commercial and public buildings, and municipal utilities.

9 Includes road, rail and aviation transportation, and natural gas and oil pipelines.

Downside of the Energy Superpower Strategy

The intimate relationship between energy supply and energy efficiency is too often overlooked. Russia's rejection of the Energy Charter Treaty (ECT)—which it helped draft and adhered to for fifteen years—comes at a heavy price on both sides of this energy equation.

On the supply side, Russia will find it more difficult to get the financing and international partnerships necessary to develop and market its enormous natural gas resources. The development of new resources is essential if the export market is to regard Russia's natural gas as a reliable resource.

Russia has the world's largest reserves of conventional natural gas, but production has not kept pace with rising domestic and export demand. The output from mature gas fields is declining. The pinch captured headlines in the winter of 2005–2006 when Russia cut exports to Serbia, Bosnia and Herzegovina, Croatia, Italy, Romania, and Poland. Supplies to domestic customers were cut between 5 billion and 6 billion cubic meters, including costs to power stations of as much as 80 percent of their contracted supply volumes.[11]

Gazprom's investment plans are only about half the amounts required to meet future demand, according to the International Energy Agency. Russia's rejection of the ECT will make it more difficult to attract additional investments and will stimulate the search for alternative sources and pipelines and the production and use of unconventional gas.

On the energy-efficiency side, the cheapest way to maximize Russia's natural gas stores is to minimize waste through cost-effective, domestic energy-efficiency programs. The World Bank report estimates that energy efficiency would be able to save natural gas at one-third the cost of building new energy supplies. Doing both—increasing energy efficiency and investing in new supplies—is the sensible answer.

The rejection of the ECT also will handicap Russia's ability to reach its new energy efficiency goals. The treaty requires each party to minimize, in an economically efficient manner, any harmful environmental impacts from energy use. To achieve this, the companion Energy Charter Protocol on Energy Efficiency and Related Environmental Aspects (PEEREA) was created. It requires each member to formulate an energy efficiency and environmental impact policy. The policies are expected to include taxation, pricing policies, environmental-related subsidies, and financing.[12]

The chairman of PEEREA was a Russian, Dr. Victor Shakhin, a veteran of Russia's collaboration with other countries and international organizations. He will be missed, as will Russia's participation. The change signals that Russia places a higher priority on international energy power politics than on international energy collaboration. It will damage the international participation and financing needed to advance Russia's stated interest in strengthening its energy-efficiency programs.

RUSSIA'S ENERGY EFFICIENCY TASK

To understand the challenge facing Russia, one must look more closely at the country's energy resources and how they are used. Table 2: Fuel and Energy Balance for Russia simplifies a table assembled by CENEf for the World Bank report, which compiles 2005 information from eleven Russian reports.[13]

The table features three related blocks. The first shows the production of energy from all Russian sources. Natural gas provided 517.13 million tonnes of oil equivalent (mtoe) and crude oil 470.14 mtoe. Coal is a distant third at 134.97 mtoe. Also noteworthy are nuclear (39.72 mtoe) and renewables, which are almost entirely hydropower (15.05 mtoe). Most analysts believe Russia's oil production has peaked and will stay relatively flat in the near future; natural gas production also will change little without major investments to tap Russia's huge undeveloped natural gas reserves.

The first block also shows energy exports and imports and the resulting energy available for use in Russia: its Total Primary Energy Supply (TPES). More than half the crude oil is exported, leaving 220 mtoe. About one-third of Russia's natural gas is exported, leaving 356.08 mtoe available for use domestically. The block shows that 45 percent of Russia's production of 1191.37 mtoe was exported, leaving a TPES of 653.62 mtoe available in Russia—more than half in the form of natural gas.

The second block shows how this TPES is processed into usable forms for Russia's end-use sectors: buildings, industries, and transportation. The processes reduce the TPES to 376.65 mtoe available for consumption in these end uses, which is known as the Total Final Energy Consumption (TFEC). The largest losses are in the conversion of natural gas and coal to electricity[14] and the conversion of natural gas, coal, and petroleum products to heat. A smaller amount was used to convert crude oil into petroleum products.

The third block, TFEC, shows how the final energy sources were consumed in the three end-use sectors. The numbers show the dominant

role of natural gas. Heat is the largest form of final energy consumed, and it is largely obtained from natural gas as shown in the second block. The direct use of natural gas comes in second. Most of the petroleum products are used in transportation. Electricity is used primarily in industry and buildings.

The table shows the five opportunities to improve energy efficiency in Russia: the processing of primary energy to electricity and heat in the second block and improving the efficiency of the consumption of energy in the three end-use sectors.

The following five subsections describe these opportunities in greater detail, including the barriers to increased energy efficiency and how they can be addressed.

ELECTRICITY

To find the potential for efficiency in generating electricity and delivering it to customers, one looks at the energy used to generate it (186.74 mtoe) and the electricity delivered (TFEC: 57.52 mtoe) for an overall efficiency of 30.8 percent. The processes used to make electricity differ in their potential efficiency, and fossil fuel plants are inherently less efficient than hydropower plants.

The breakout shows major opportunities for energy savings in all these processing areas; the World Bank report estimates these savings to be 31 percent.[15] Russia's fossil energy plants had an average efficiency of 36 percent, below the average efficiency found in the OECD countries, where coal- and oil-fired condensing plants operate at an average energy efficiency of 38 percent and gas-fired condensing plants at an average energy efficiency of 41 percent and some combined-cycle gas plants achieve efficiencies of 57 percent and some coal plants reach efficiencies of 47 percent.[16] The performance of nuclear power plants was low, primarily because of their down time. The efficiency and safety of hydropower plants could be improved with modern turbines and control systems. The distribution losses from the power plants to the end users were very high (9.69 mtoe), the result of little investment in transmission and distribution systems in the past two decades.

The more than 3-to-1 loss from primary sources (TPES) to consumption (TFEC) should guide the selection of energy-efficiency priorities. An mtoe of electricity savings in industry or buildings saves more than 3 mtoe

in primary energy, including capital cost savings and a reduction in environmental pollutants.

The capture of these electricity savings will require navigating an energy-economic "perfect storm." In one of history's greatest economic reforms, the state-owned Unified Energy System of Russia, RAO UES, which dominated Russia's generation, transmission, and distribution of electricity, ceased to exist on July 1, 2008. The demise was the central event in a Russian reform aimed at reaching a fully competitive and unregulated electric market in 2011. The generating sector was divided into 20 wholesale electricity companies, which were sold to foreign and Russian buyers. These buyers acquired neglected plants, which had been underfunded since the Soviet era and lagged foreign plants in fuel rate, average efficiency, and operating time.

The recent global financial crisis made matters worse. Interfax reported in August 2009 that Russia generated 630 billion kWh of electricity from January to August 2009, down 6.6 percent from 2008. Sales were sinking, and new foreign investors, struggling with their own domestic economic issues, were hesitant to invest in modernizing existing plants and constructing new plants in Russia. Medvedev and Prime Minister Vladimir Putin are under pressure to delay lifting all price controls, which had been scheduled for 2011, because low- and moderate-income Russians are struggling to pay their bills.

The World Bank report was prepared before RAO UES shut down, yet many of its recommendations remain valid. They affirm support for the continued increase of tariffs to full cost-recovery levels. The report warns that power companies tend to exaggerate the need to build traditional, new power plants. The location of new power plants should respond to the changed, concentrated areas of consumer demand. The transmission and distribution system should recognize the advantages of cross-regional power trading. Electricity planning should be more closely integrated with heat planning to achieve the efficiencies of combined heat and power.[17]

Electricity tariffs would need to increase significantly to provide the financing necessary to become a modern, reliable system. Yet higher tariffs carry the risk of a customer revolt, particularly when the payments are going to new, foreign-owned companies. An aggressive energy-efficiency program focused on reducing customers' electricity consumption and providing offsets for tariff increases could help defuse any angry outcry that would threaten reforms.

Writing in the *European Energy Review*, Jeroen Ketting emphasized this connection.

> With prices being sure to rise as a result of the electricity reform, the cheapest and most direct strategy to guarantee a sufficient supply of electricity in Russia and to minimize the negative for households and businesses is to increase energy efficiency for both residential and industrial customers. Energy efficiency, after all, is the only real long-term guarantee for a healthy electricity sector.[18]

HEAT

Medvedev was on target when he described the heating and public utilities as "atrociously inefficient" and the building infrastructure as "a kind of black hole that sucks in enormous amounts of energy resources."

The district heating systems that provide Russians with heat and hot water provide the largest opportunity for energy savings, according to the World Bank report.[19] They also are the most complicated.

Centrally located district heating plants produce steam or hot water, which is distributed to buildings and other customers through feed and return pipelines. The plants are heat-only boiler stations or cogeneration units, also called combined heat and power (CHP), that produce heat and electricity. Well-designed and well-maintained district heating systems can be a model of energy and environmental efficiency. Old, poorly designed, and poorly maintained systems can be disastrous. (I had experience with both as director of the Minnesota Energy Agency in the late 1970s. See "From Buhl to President Bush" box.)

As shown in the second block of Table 2, natural gas is the dominant primary energy source for heat, three times larger than coal and ten times larger than petroleum. Energy losses in producing heat occur in three places: first, in the production of hot water and steam at the primary energy sources; second, in the distribution of the hot water and steam through the rarely insulated pipes to the end users; and finally in the often-porous housing. (This will be addressed in the Energy-Efficient Buildings section.)

The need to stanch this hemorrhage has been recognized since the early 1990s. The World Bank, EBRD, and other financial sources,

From Buhl to President Bush

I saw the bad and the good sides of district heating firsthand when I was director of the Minnesota Energy Agency (MEA) in the late 1970s.

In early October 1977, Governor Rudy Perpich summoned me to his office and told me to head to Buhl, a town on the Iron Range that was having an energy emergency. Buhl had a district heating system but no coal, and winter was fast approaching.

The Midwestern coal strike the previous summer had sent coal prices soaring, and Buhl's response was to not pay for its coal. Now it was out of coal and unable to get any more. Opinions varied on whether the ancient system was worth saving. It created jobs, but the distribution pipelines were so leaky they melted the snow on the ground above them, making paths for children to walk to school. Some households had converted to propane or heating oil, but others had not. The pattern was random.

I spent much of my time in Buhl that early winter, working with local leaders for an orderly shutdown of the system, shrinking its service area section by section, getting homeowners to convert to alternative fuels by section and providing a state guarantee for the coal needed in the staged shutdown of the plant.

About the same time, the U.S. Atomic Energy Commission, later absorbed into the U.S. Department of Energy, was touting the potential of cogeneration, or capturing the unused heat from nuclear power plants and using it for district heating. Swedish energy leaders had similar thoughts, and the two countries pooled their resources in a call for proposals. The MEA won the competition and funded a study on piping hot water to Minneapolis/St. Paul from the Prairie Island nuclear generating plant about 100 miles southeast on the Mississippi River.

The study concluded that the distance was too great to make the heat pipeline connection economically attractive, but that a district heating plant in St. Paul using Sweden's modern hot water technology would be a winner. I visited Sweden to learn more about its district heating, became a convert, recognized we would need a Swede to explain it in St. Paul, and asked the Swedish district heating association for a suggestion.

The stars were aligned: Hans Nyman, who ran the Uppsala district heating system near Stockholm, was interested and brought his knowledge and credibility to St. Paul. Mayor George Latimer became district heating's champion, and the largest, most successful U.S. hot water district heating system was born. Nyman moved his family to St. Paul, where he became president of District Energy St. Paul and a leading innovator in the International District Energy Association.[20] The St. Paul system continued to innovate, adding district cooling, chilled water storage, and a combined heat and 25 megawatt power plant powered by wood residue.[21]

The national spotlight fell on District Energy St. Paul on May 17, 2001, when President George W. Bush went there to release his National Energy Policy. It was a fitting backdrop as the president summarized the potential benefits of district heating, calling the new power plant

> … a model of energy efficiency. It is also a model of energy diversity. It uses conventional fuels like oil and natural gas and coal, and renewable fuels like wood chips. And the plant is a model of affordability. While other energy prices rise, District Energy has not raised its heating and cooling rates in four years.

foundations, and private companies have participated in successful district heating projects, primarily in western Russian cities that have shared Russia's economic recovery. The World Bank and International Energy Agency have hosted conferences on how to solve Russia's district heating conundrum.

These efforts have yet to reach much of the struggling heartland. Russia has 17,000 municipal district heating systems—far more than any other country—and large swaths of the country are struggling with Soviet-era systems. Heat-related subsidies are the single largest cost in many municipal budgets. The needed remedies—short term and long term—are set forth in reports including that by the World Bank.[22]

The first step is to get basic information on the heat systems' operations. There is little metering at the local plants, the buildings served, or individual apartments, so often there is no way to measure production or consumption. In high-rise apartment buildings, temperatures are controlled in winter by opening or closing windows. There is no way to measure heating distribution losses and prioritize cost-saving retrofit measures, nor is there aggregated data for use in drafting changes in the municipal heat-supply plans.

Concurrently, tariffs must be changed to encourage investments that lower production and operation costs. Political influence has kept many local tariffs below cost-recovery levels, and recent federal legislation limited increases until 2010 to soften the effects of the recession. Regulators limit the allowable recovery of distribution losses at 13 percent, although they are double that in some systems; this further lowers cost recovery. The inadequate tariffs make it virtually impossible for many systems to obtain financing for basic rapid-payback improvements.

Progress will depend on municipal heat-supply plans that are tailored to local conditions. Investment options including heat-only boiler and/or CHP improvements must be balanced against improvements in the distribution system. Some systems will be replaced by heating units in individual buildings, some will be modernized, and others will serve a smaller territory. The CHP option should be integrated with the planning for the electricity grid and the heat and electricity requirements of local industries. Estimates of future heating requirements must be reduced to reflect the savings of an aggressive energy-efficiency program for housing and other buildings. Any energy-saving program must include methods for winning public acceptance of the higher tariffs required to finance

this reform. Workable long-term options for financing the reform must be central to the planning, including the option of transforming the systems into commercial entities.

This is a tall order, but Russia has few other options; failing to address this problem makes it larger in the long run.

INDUSTRIAL ENERGY EFFICIENCY

The industrial sector is the second largest end use in Russia, following the buildings sector, and consumed 124.68 mtoe in 2005,[23] the year referenced in the World Bank report. Nearly two-fifths is in the form of heat; the other major savings are in natural gas, coal, and electricity.

The World Bank report reviewed energy-efficiency activities worldwide to determine which improvements were technologically feasible. It then estimated which would be economically viable in Russia, providing a reasonable payback when viewed from the overall Russian perspective, and which would be financially viable, providing a reasonable payback to those who pay for the energy.

The energy tariffs of Russian companies are closer to cost-recovery levels than those of residential and commercial building customers, and 80 percent of the energy-saving measures would be financially viable to the customers. These measures would pay for themselves, then continue to provide additional savings. Yet cost-effective investments have not been made for two reasons: a general lack of awareness among managers that these savings are possible, and no access to mid- or long-term capital to finance energy-saving investments.

The effect of these barriers is evident in a comparison of the energy intensity, or energy required to manufacture a product, in Russia and competing countries. The most energy-intensive industries in Russia are ferrous metals, pulp and paper, and cement; combined, they represent 53 percent of the sector's energy-saving potential.[24] Russia is behind all other countries in the energy intensity of its pulp and paper and cement industries and is tied with Romania in using the most energy to produce ferrous metals.

The solution depends primarily on two joined efforts: informing industry decision makers at all levels about energy-saving measures they can take, and providing easy access to capital to enact these measures in a form that is realistic, multi-year, and has low transaction costs.

Raising tariffs on electricity, natural gas, and heat should get the attention of Russian industry leaders: The World Bank report estimates that tariff increases would lower the profits of Russian companies by at least 15 percent.[25]

Maintaining Russia's economic competitiveness will require rapid adoption of energy-efficiency measures. Yet that urgency must not override the exercise of quality control in implementing the efficiency measures. Successful industrial energy-saving programs require metered energy use; energy audits that prioritize energy-saving investments; monitoring consumption before and after the projects; transparency in reporting the results; sharing information on the lessons learned; and human resource development.

These changes won support in the energy-efficiency law that the State Duma approved in December. The new law mandates audits by all industrial enterprises and uses tax breaks and investment credits to encourage businesses to adopt energy-saving policies. It bases energy tariffs on how efficiently energy is used, and consumers can earn credits and subsidies for installing energy-metering systems.

ENERGY-EFFICIENT BUILDINGS

The building sector, including residential, commercial, and public buildings, is the largest end-use sector in Russia, consuming 40 percent of all TFEC. Most of that energy—70 percent—comes from natural gas, either directly or for generating electricity and producing heat used in buildings. This makes buildings the focus for energy-efficiency efforts that free up natural gas supplies. This sector also has the greatest potential to improve final energy consumption, according to the World Bank report.[26]

The residential sector consumes nearly three-fourths of the sector's energy; commercial and public buildings consume the rest.

Buildings are the other half of the "black hole" of wasted energy Medvedev mentioned, along with the antiquated district heating systems discussed above. Three-quarters of Russia's buildings get their heat and hot water from district heating, so energy-efficiency programs in the heat and buildings areas must be closely coordinated.

The mandatory energy code for new buildings approved by the State Duma in December should start to reduce this waste. A recent study of Russia's multifamily high-rises found dramatic differences in heat

intensity between existing and new structures. The average heat intensity of existing buildings was 229 kilowatt hours per square meter per year (kWh/m^2/year). For new buildings, the figure was 77 kWh/m^2/year, about one-third as much. Recently retrofitted buildings averaged 151 kWh/m^2/year.[27] The difference between new and retrofitted buildings' heat intensity illustrates the rule of thumb that it costs twice as much to save energy through retrofitting an existing building as it does to capture the savings in the design and construction of a new building. Buildings last longer than factories or cars, so it's important to get them right the first time. The State Duma's action is laudable, erasing an uncertainty over the status of the building energy code. Now begins the hard part—as found in the United States and other countries—putting together an effective implementation and enforcement program.

Existing buildings offer a larger opportunity for energy savings. The challenges in making them more efficient are similar to those faced in the industry sector: educating and stimulating the large, diverse group of decision makers on the benefits of energy efficiency, and providing workable financing for energy-saving measures.

Meeting the first challenge requires meters, tariffs, and education. The need for metering in heat-supply systems includes the need for meters in buildings to show how the heat is used. Without data from meters, it will be hard to gain acceptance of increased tariffs or show consumers how cutting their usage could save them money.

Metering the heat consumption of apartments in buildings throughout Russia poses a unique challenge. The heat is customarily provided through vertical pipes, several of which pass through each of the stacked apartments, heating radiators along the way. There's no economical way for a single meter to measure an individual apartment's consumption. (Apartments can be metered for electricity and direct use of natural gas.) Large areas of the buildings are common areas, where no individual apartment owner is responsible for heating. Numerous demonstration projects in Russia have explored creative answers to this problem; the lessons from these projects must be shared so that retrofitting programs can succeed.

The meters, tariffs, and information will go for naught without attractive financing for energy-saving investments. The World Bank report offers several solutions[28]:

- A capital repairs loan guarantee facility. These facilities guarantee loans to owner associations for capital repairs. The guarantee reduces the banks' perception of risk and encourages banks to work with homeowners associations (HOAs). Owners are encouraged to take responsibility for their property. Several Central European countries with similar problems have found success with this approach.

- Standardized, performance-based management contracts for HOAs and building management companies. HOAs can aggregate the homeowners' funds for improvements in common areas. Building management companies can serve as energy service companies (ESCOs), delivering energy-saving measures and guaranteeing performance for a fixed fee.

- Incentives for more widespread metering. Besides being essential for effective tariffs, meters focus attention on energy consumption among consumers who have never had access to this data. In Rostov consumers who received meters reduced their heat use 12 percent to 37 percent and their hot water use 10 percent to 33 percent compared with the consumption norm. Homeowners could monitor and manage their own energy use.

The increased global attention on energy and climate change means more interest in mandatory efficiency standards and labels for appliances and equipment. This has been one of the most cost-effective ways to save energy in the United States and other countries. Most countries in the Organisation for Economic Co-operation and Development have standards and labels programs, and the number of countries and products covered is growing. Consider the effects of the European standards and labels program for refrigerators: The year-on-year increase in the sale of the most efficient class of refrigerators grew from 5 percent in 1995 to 23 percent in 2000 and 61 percent in 2005.[29] The use of standards and labels has expanded from common household appliances to lighting, electric motors, transformers, and other energy-using equipment.

In Russia, where energy efficiency is gaining increased attention, mandatory federal standards for appliances and equipment used in buildings could be an effective first tool for eliminating energy waste. The usual guideline for setting standards is that they achieve the maximum energy savings that are "technologically feasible and economically

justifiable." This helps assure that manufacturers can ramp up to meet the new standards and buyers see a reasonable payback period. The companion label programs identify products with efficiencies that exceed the standards, which would help Russian buyers find energy savings as they respond to rising tariffs.

Energy-efficiency programs in housing could be designed also to address one of Russia's most serious human problems: its poorest citizens' economic vulnerability. A large portion of Russia's people is clustered near the poverty line. A 2008 World Bank report estimated that fully 26 percent of Russia's population is vulnerable to falling beneath the poverty line.[30]

Superficially, Russia would appear to rank among the most generous supporters of its citizens, spending 2.6 percent of its GDP on noncontributory spending for them. Most countries spend 0.5 percent to 2.0 percent. Russian subsidies exceeded $50 billion in 2007, according to the IEA's World Energy Outlook 2008, placing it second behind Iran among the non-OECD countries, which dominate the subsidy payouts. China, Saudi Arabia, India, and Venezuela trailed Russia by more than $10 billion. Virtually all Russia's subsidies were on natural gas and electricity—largely generated by natural gas.

However, up close, a less charitable picture emerges. Russia provides across-the-board subsidies on electricity and heating bills. Those with higher incomes use more electricity and heat than the poor, so they—not the needy—receive a higher share of the benefits.

Eliminating tariff subsidies, coupled with focused assistance for the poor that includes support for the energy retrofit of their housing, would address this serious human problem. It could also help set the stage for addressing a related problem: the housing shortage and overcrowding that affects many Russians, particularly the poor.

The energy-efficiency legislation approved by the Duma in December is encouraging. In addition to energy-efficient building codes, it includes energy-efficiency standards and requires labels for appliances and equipment; installation of meters in residential and commercial buildings; and an information campaign to inform the public of the benefits of energy efficiency and how to achieve it. The legislation calls for the government to set an example, requiring that government-funded sectors reduce their energy consumption from 2009 levels by 30 percent within five years.

ENERGY-EFFICIENT TRANSPORTATION

The transportation energy use in Russia is relatively small compared with that in the United States and other OECD countries, especially when one considers the energy used by pipelines and the transportation needs of a country spread across eleven time zones. More than one-third (37.7 percent) of the 94.4 mtoe of final transportation energy consumption was used to move natural gas and oil through pipelines, leaving 15.6 percent of Russia's final energy consumption for conventional road, air, rail, and water transportation. The United States used 39.2 percent of its final energy consumption for transportation in 2007.

The bulk of the energy for conventional transportation came from petroleum products (52.76 mtoe). The bulk of the pipeline consumption was natural gas pumping stations used to move natural gas (32.35 mtoe).

The low transportation numbers are not evidence of energy efficiency, but of a weak appetite for car ownership that is rapidly growing. Private car ownership increased 84 percent in Russia between 1995 and 2006, according to the World Bank.[31] Many buyers seek inexpensive, imported, secondhand gas guzzlers. Russians' use of public transportation declined by 23 percent from 1995 to 2006. Use of buses dropped 50 percent, and the number of city and inter-city buses running declined by 43 percent.

The World Bank report recommends better information and a mix of efficiency standards, financial stimuli, and education strategies to slow Russia's accelerating use of energy for transportation.

The shortage of data on energy use in transportation impairs policy decisions. It is most acute on data for privately owned vehicles, the largest and fastest-growing subsector. Information on vehicle stock, passenger and freight turnover, average mileage traveled, and fuel consumption is contradictory.

The financial signals also are contradictory. Vehicle owners are not charged the true cost of usage, congestion, pollution, and climate change. Transportation tax policies are often ignored and, when followed, too small to make a difference. Public transport is crowded, uncomfortable, unreliable, and slow. Municipalities lack access to the medium- and long-term financing necessary to improve their transportation infrastructure.

These problems are not unique to Russia, and other countries have addressed them successfully. Mandatory fuel efficiency and emission

standards can upgrade new vehicles. Labels can be required on new cars showing their energy efficiency and CO_2 emissions. Increasing fuel taxes can tame the appetite for SUVs. Vehicle taxes, registration fees, and purchase taxes can be used to upgrade transportation infrastructure, and creating high-occupancy vehicle lanes can encourage ride sharing. London reduced central-city traffic by 20 percent through an entrance tax on vehicles. New York City promoted public transportation by increasing frequency on key routes, improving punctuality, and marketing aimed at middle- and upper-class residents.

Government agencies can include these pieces in a policy for sustainable transport that integrates land use, urban planning, traffic management, and intelligent transportation systems. The World Bank report challenged government to "lead a change in public values, emphasizing, perhaps that cities are meant and designed for people, not for cars."[32]

Pipelines also offer opportunities for significant savings. The energy intensity of crude oil transportation increased 76 percent from 2000 to 2005. Petroleum products' energy intensity increased 23 percent, and natural gas was relatively stable. The World Bank report cites a U.S. Environmental Protection Agency report that found potential savings of as much as 50 percent in the transport of natural gas through "catching" leaks, matching power to loads, audits, and maintenance measures.[33] Gazprom's estimate of the technical potential of the savings in Russia was more conservative.

OTHER ENERGY OPPORTUNITIES

Changes in the five major energy areas—electricity, heat, industry, buildings, and transportation—can be further enhanced by the capture of flared gas, research and development on advanced technologies, and development of human resources.

FLARED GAS

Although it doesn't show up in the Russian energy balance, the burning off of flared gas (Associated Petroleum Gas, or APG) from oil wells is one of the most appalling wastes of a precious resource.

Here again, the numbers are clouded. Russia's official estimate is that

16 billion cubic meters (bcm) was flared in 2006; only Nigeria wasted more.[34] Putin recently acknowledged that the figure exceeded 20 bcm, and a recent World Bank–supported study estimated the number was as high as 38 bcm.[35]

As the World Bank report warns, gas flaring has three negative results. First, potential revenue is lost. Second, flaring emits greenhouse gases; this problem is compounded by the fact that Russia's flares are inefficient and release methane, a gas with more than 20 times the heat-trapping power of CO_2. And finally, flaring releases pollutants such as carbon, methane, sulfur, and nitrogen—all harmful to human health.

Other countries have developed comprehensive plans to reduce gas flaring. These include legislation limiting flaring; rigorous monitoring; third-party access to pipelines; price liberalization; heavier fines; and creation of independent regulatory bodies. Russia has started to limit flaring and introduced legislation to require the use of 95 percent of the flared gas. This is a worthy goal; however, it will not be achieved without a program that establishes limits, combines rewards and penalties, and monitors and enforces compliance.

RESEARCH AND DEVELOPMENT

The World Bank report is filled with information on how to achieve its recommendations, yet none of the sources cited is Russian. Outstanding energy-efficiency science and analysis are being conducted in Russia, but this lack of citations (and corresponding lack of publications) illustrates how little emphasis has been placed on the subject by many Russian government, industry, and university leaders. Yet these scientific and technological advances are essential for a sustainable future.

The report's conservative estimates of potential energy savings are based on past experience; it does not consider what is possible in the future. This raises a question: What role does Russia want to play in identifying, developing, and applying advanced technologies for increased energy efficiency and renewable energy?

Russia's previous leaders saw little need for energy efficiency, so the country never developed a national energy research plan. Medvedev's comments could serve as a wake-up call. One part of that awakening could be a commitment to energy efficiency research and development. This would signal that a balanced energy policy has become a national priority and would help tailor the advances made in energy efficiency to Russia's unique problems.

HUMAN RESOURCE DEVELOPMENT NATIONWIDE

A comprehensive energy-efficiency program cannot work without training a nationwide corps of information specialists, engineers, administrators, and workers. This will be expensive in terms of time and money, but the resulting increased capacity will pay off in terms of the labor force, national economy, and saved energy. Reducing energy intensity increases labor intensity, which means jobs will be created nationwide. Supplying natural gas and electricity to a building requires only so many workers; far more are required to insulate it; install meters; replace old appliances, windows, doors, and lighting; caulk air leaks; conduct before and after energy audits; and educate the occupants about how to lower their energy bills.

Medvedev was wise to select the State Council Presidium of the Russian Federation for his call to action on energy efficiency. The Presidium members represent Russia's seven federal districts and convey the central government's priorities to the 83 federal subjects. Energy efficiency works from the ground up, and the federal subjects and municipalities are where the important work will be done. Local leaders must be on board for reforms to take place; after all, they will be closest to the people when tariffs are increased, assistance is focused, energy efficiency measures are promoted, jobs are created, financing is obtained, debts are incurred, and district heating service areas are changed.

ENERGY AND CLIMATE CHANGE

Russia has played a pivotal role in studying climate change. In the mid-1950s, Mikhail Budyko pioneered physical climatology and the phenomenon of global climate change. A half century later, Russia ratified the Kyoto Protocol, giving it the approval needed from countries accounting for at least 55 percent of the total carbon dioxide emissions for 1990 and enabling the protocol to come into force February 16, 2005.

In Copenhagen, however, Russia was a bit player, as were the European Union and Japan. All three had signed the Kyoto Protocol and were expected to support whatever agreement came out of the Copenhagen conference, although they no longer had swing votes on the outcome. The spotlight was on the United States, China, and India. Russia's significance was diminished when the focus on emerging powers shifted from BRIC (Brazil, Russia, India, and China) to BASIC (Brazil, South Africa, India, and China).

Russia's ratification of Kyoto had been motivated more by self-interest than environmental interests. The protocol used 1990 figures to determine countries' emissions allocations, and by 2000 Russian emissions had fallen about 30 percent from that benchmark; they climbed slowly in subsequent years, but have retreated in the recent global recession. Medvedev went to Copenhagen offering a 25 percent reduction in emissions in 2020 from the 1990 base. Environmentalists were not impressed, although the offer meets the requirements of the weak Copenhagen Accord.

Alexei Kokorin, head of the World Wildlife Fund's Russia climate program, characterized Medvedev's offer like this:

> In terms of the "percentage" for 2020, we are actually the leader among the major countries. But it's not just a matter of the percentage—what's more important is to stop the growth in emissions and to start to reduce them. That's what will show whether Russia is developing on the basis of new systems rather than the old ones.[36]

Medvedev recognizes that energy efficiency and climate change give Russia a significant opportunity. Speaking at a conference on power engineering following Copenhagen, he said:

> Even if the talk about the climate and the global changes taking place in the environment is not confirmed, as a minimum we shall lose nothing, because we shall engage in energy efficiency and have a certain effect on improving the surrounding world. But if, God forbid, what the scientists are currently saying turns out to be true in one way or another, it still definitely follows that that is what we have to do. So that means we win either way.[37]

He expanded and formalized Russia's position by issuing the Climate Doctrine of the Russian Federation on December 17, 2009. The eight-page doctrine sets forth a comprehensive view of Russia's goals, principles, and policies on climate change. The document notes the negative effects of climate change: health risks, droughts, forest fire risks, permafrost degradation, ecological imbalance, and increased power consumption for air conditioning. It also notes expected positive effects: expanded cultivation area, increased productivity from boreal forests, reduced ice in the Arctic seas, and decreased energy consumption for heating. The doctrine draws a strong connection between climate change and energy, closing with the statement that Russia's adaptation and mitigation goals will be met by enhanced efficiency in thermal and electric power, vehicles, industries, and buildings, and by increasing the contribution of alternative energy sources.[38]

THE WAY FORWARD

Many energy-saving projects and studies have been completed since the 1991 emergence of modern Russia, but its energy intensity remains higher than that of other major developed or transition countries. However, the leaders of Russia—the country with the largest amount of energy resources—are now voicing support for energy efficiency and its economic, environmental, and social benefits.

Russia still faces significant barriers in transforming its energy system from a preoccupation with production to one that embraces sustainability. For the past 20 years, Russia's priority has been to produce and export energy. The electricity, heat, industry, building, and transportation infrastructures have been severely under-funded. Aged district heating systems in many cities must be renovated or shut down, which will have severe social and economic consequences that must be addressed. The necessary changes extend from Moscow through Russia's vast government hierarchy.

Russia brings unprecedented resources to this task of transformation. The value of its energy resources could become a large source of financing. The oil and natural gas saved through efficiency can be exported, helping to make the effort self-supporting. The World Bank and EBRD have provided major funding for energy-efficiency projects and studies and bring a constructive fiscal discipline to their projects. Russia has been slow to embrace energy efficiency, but in the meantime many countries have undertaken similar projects; Russia can learn from their experience. In climate change, Russia is in an enviable position where increasing its energy efficiency to meet its own social, environmental, and economic goals will also lower its GHG emissions and strengthen its position in whatever agreement follows the Kyoto Protocol. The human resources to implement the energy-efficiency measures are available throughout Russia, particularly in the southern and eastern districts where unemployment is high. Training will take resources and time, but the results will create jobs and improve the economy in some of Russia's most depressed areas.

A consensus is forming on what needs to be done. The World Bank report provides a blueprint. The change must be broad in scope, covering the integrated delivery of primary energy and its efficient end use. The change must apply an effective combination of information, standards, incentives, and financial support. And it must be delivered effectively through the federal, district, subject, and municipal infrastructure. The change will require time, resources, and commitment, but the results will be well worth the effort: Russia will emerge with a modern energy system that better serves its people and strengthens its international role.

NEXT STEPS

The conditions needed to reshape Russia's abundant energy and human resources into a modern economy are converging. Russia's leaders offered strong support for conserving and efficiently using Russia's energy resources. The negative consequences of energy waste—financial, economic, environmental, and social—are obvious. Goals have been set and plans adopted.

But achieving those goals won't be easy. The decades since the collapse of the Soviet Union have been full of struggles to survive, let alone prosper; these hardships create fatigue and can narrow perspectives. Modern Russia's enlightened leaders are struggling to move forward.

Representatives of government agencies, corporations, financial institutions, nongovernmental organizations, and foundations often meet and discuss their shared issues, but their focus is primarily on immediate challenges. They give little attention to the underlying changes that are essential for Russia to become a modern economy.

The necessary first step is to bring these key players together to focus on these underlying changes. For this meeting to succeed, key stakeholders must understand the meeting's broad purpose and offer their views on what reforms are needed and what they are willing to do.

The representatives of these stakeholders would be asked to participate in the drafting of an approach that will guide this meeting. All Russian districts and groups with a stake in the planned changes must be included in these preparations.

This meeting will not be about discussion; all talk about the problems of Russia's economic modernization should occur before the summit. That collaboration should result in a draft plan of achievable short-term, mid-term, and long-term goals that advance participants' vision of Russia's future. The meeting itself will be about action: refining these goals and coordinating an effort by government, industry, financial institutions, and nongovernmental organizations to achieve them.

NOTES

1 See “Excerpts From President Dmitry Medvedev’s Comments” box for additional Medvedev comments at the Arkhangelsk meeting.

2 China passed the United States in 2007 to become the largest source of GHG emissions. The European Union would rank third, but is not counted in the ordering of sovereign states.

3 World Bank, *Energy Efficiency in Russia; Untapped Reserve*s. English translation. 2008, p. 28.

4 Total energy consumption includes the end-use energy consumption on sites, e.g., buildings and manufacturing plants, and the energy consumed to transform and deliver energy, e.g., electricity and heat, to the sites.

5 *Energy*, vol. 12, no. 10/11, Pergamon Journals Ltd. Great Britain.

6 The author was the director of the Department of Energy’s U.S. Country Studies Program and U.S. Initiative on Joint Implementation. He assumed management of the Russian Countries program when its initial manager, Jonathan Elkind, resigned from DOE. Elkind recently returned to DOE to become the Principal Deputy Assistant Secretary of the Policy and International Office.

7 I was saddened to learn that Dr. Matrosov died unexpectedly of a heart attack on February 7.

8 World Bank, *op. cit.* p. 5.

9 The ECT website is http://www.encharter.org.

10 David Clark, “Russia’s Unsustainable Energy Model,” *Financial Times*, October 16, 2009.

11 World Bank, *op. cit.* pp. 16–18.

12 More information is available on the ECT website, http://www.encharter.org.

13 World Bank, *op. cit.* pp. 125–127.

14 In the electricity sector, the six sources provided 186.74 mtoe (represented by the minus signs) to generate 81.98 mtoe of electricity.

15 World Bank, *op. cit.* p. 51.

16 *Ibid*.

17 *Ibid*. pp. 105–112.

18 Jeroen Ketting, “The End of the Russian Electricity Sector and the Beginning of a New One,” *European Energy Review*, March/April 2008.

19 World Bank *op. cit.* p. 39.

20 Nyman died of cancer in 1993. In his honor, the name of the company he helped create was changed to the Hans O. Nyman Energy Center.

21 For more on District Energy St. Paul, see http://www.districtenergy.com. For more information on Hans Nyman see the article by Hans Sandberg, "How St. Paul Got Energy," *Currents Magazine*, Spring 2006.

22 World Bank, *op. cit.* pp. 100–105.

23 To simplify this analysis, similar end uses have been combined under the industrial topic. End uses and their consumption are: Manufacturing, 109.54 mtoe; mining, 7.19 mtoe; agriculture and forestry, 6.21 mtoe; construction, 1.70 mtoe; and fishing, 0.04 mtoe.

24 World Bank, *op. cit.* p. 46.

25 *Ibid*. p. 21.

26 *Ibid*. p. 39.

27 *Ibid*. p. 41. The new buildings in this review were projects financed by various financial institutions, foundations, and other sources and probably attracted energy-conscious architects and builders. Because of this, the energy per square meter reported for new buildings probably is lower than the average of all new buildings in Russia, but it represents the performance that is possible applying modern practices.

28 *Ibid*. pp. 81–83.

29 *Ibid*. p. 84.

30 The World Bank in Russia, Russian Economic Report no. 18, *Poverty, Vulnerability and Inequality in Russia During 2002-06*, March 2009, p. 21.

31 World Bank, *op. cit.* p. 60.

32 *Ibid*. p. 118.

33 *Ibid*. pp. 62–63.

34 *Ibid*. p. 19.

35 *BP Statistical Review of World Energy*, 2007.

36 *Rossiyskaya Gazeta* (Russia), December 23, 2009.

37 *Ibid*.

38 President of Russia Official Web Portal, Unofficial translation, December 17, 2009. http://eng.kremlin.ru/docs/2009/12/223509.shtml.

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John P. Millhone is a visiting scholar in the Carnegie Energy and Climate Program. He currently is evaluating and commenting on U.S. energy policies and focusing on clean energy and economic stimulus initiatives. He is also providing analysis to the U.S.–China provincial and municipal energy efficiency management program.

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