Climate Change Mitigation: Case Studies from Russia

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Advanced
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CLIMATE CHANGE MITIGATION:
CASE STUDIES FROM RUSSIA

Sergei Avdiushin
Inna Gritsevich
Susan Legro (editor)

With contributions by:

Alexander Kolesov
Svetlana Sorokina

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Advanced International Studies Unit
Pacific Northwest National Laboratory
Washington, DC 20024

Foreword

The Advanced International Studies Unit (AISU) of Battelle, Pacific Northwest National Laboratory developed a series of case studies to document an important trend: the emergence of cost-effective carbon mitigation opportunities in transition economies. The following report focuses on three cases describing innovative Russian approaches to mitigation. This research captures the essence of AISU's approach to environmental problem-solving. First, the case studies address an actionable, global policy issue. Second, they focus on policy tools that enhance economic well-being. Third, they provide first-hand analysis from Russian experts.

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William U. Chandler
Director, AISU

For further information about the work of AISU, contact:

Advanced International Studies Unit
Battelle, Pacific Northwest National Laboratory
901 D St., SW
Washington, DC 20024 USA
Telephone: 202-646-5242
Fax: 202-646-5233
Internet: http://www.pnl.gov/aisu

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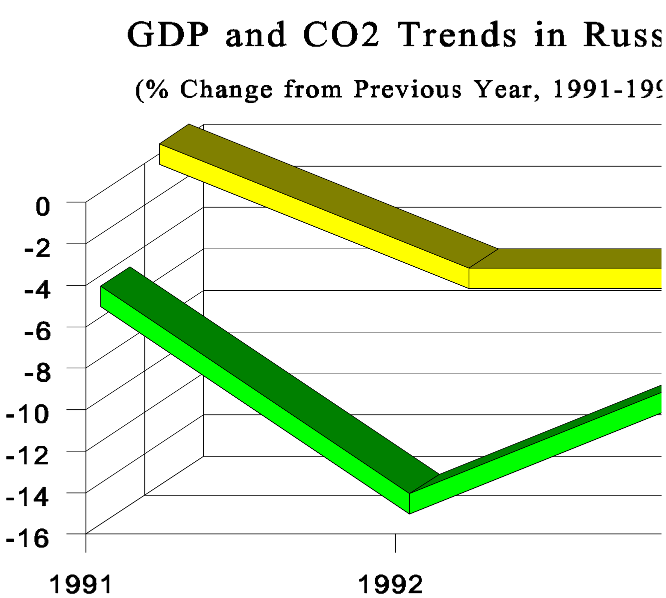
Introduction

Russia was re-established as an independent state in 1991. Four years later, the country's gross domestic product (GDP) had dropped to 60 percent of its 1990 level. This economic crisis resulted in dramatic price increases and unemployment. A corresponding drop in industrial production led to a significant decline in energy consumption: primary energy consumption decreased 25 percent from 1990 to 1995. Electricity consumption and production also decreased 20 percent over the same period.

While declines were steep in the thermal power generation sector, heat production and consumption levels (which reflect residential use) have been relatively stable. The energy intensity of Russia's economy has actually increased since 1991 (see Figure 1). Despite a net reduction in primary energy consumption in the past 6 years, the Russian economy actually became more energy intensive. Reductions in output outstripped reductions in energy use.

Figure 1. GDP and CO_2 Trends in Russia, 1991-1993



Russia signed the Framework Convention on Climate Change (FCCC) in Rio de Janeiro and ratified it in December 1994. In accordance with the procedures of the convention, Russia submitted its first national communication to the FCCC in the autumn of 1995. Russia's participation in the convention is significant because Russia is one of the largest emitters of greenhouse gases (GHGs) in the world. Russia has also established the Interagency Commission for Climate Change Problems, which coordinates Russian climate change policies and programs. The commission monitors compliance with the FCCC and studies the economic impact of emissions mitigation programs on the country.

As a result of its economic downturn, Russia will not have to implement special measures to return to 1990 GHG emission levels. Therefore, the no-regrets projects described in this report did not originate as climate change mitigation activities. They focused instead on improving economic efficiency and competitiveness, addressing local and regional environmental problems, and conserving fuel. Because GHG reductions were a secondary benefit, they were not measured explicitly in the normal course of the projects. Therefore, the authors have had to rely on rough estimates when describing the emissions mitigation benefits of the projects.

Case Study 1: Improving District Heating Efficiency in the Metallurguichesky District of Chelyabinsk

Background

The Metallurguichesky District is an industrial neighborhood that houses 145,000 residents in the city of Chelyabinsk, a Russian regional capital. The economic situation in the district is a microcosm of the difficulties facing Russia as a whole: in 1995, industrial output decreased by 22 percent, resulting in losses of $880 million. The district has its own centralized heating system, and 24 schools, 65 nurseries, 9 hospitals, and many households depend upon the system for their heat and hot water.

The cost of providing heat and hot water now consumes 34 percent of the entire municipal budget of Chelyabinsk. The city pays for the energy used in public buildings such as schools and hospitals, but it must also subsidize the cost of heat and hot water for its residents, who are unable to pay the full cost of the heating their homes. The Metallurguichesky District alone spent at least $13 million in 1996 in the form of heat and hot water supplies and subsidies for housing developments and public buildings. As a result, the combination of heating supply costs and subsidies has become the most serious economic problem in the district. Quality is another pressing issue in the heating system; currently, no reserve heat source exists in the district.

There are three main sources of heat for municipal and factory-owned housing in the district: 1) a co-generation plant at the Mechel ferrous metallurgy enterprise; 2) the peak load boilerhouse at Mechel; and 3) a boilerhouse in the Kashtak housing development. Heat distribution is handled by two organizations: the Public Service Department at the Mechel factory, and Remzhilzakazchik,[1] which relies upon a company called "ENTOS" to buy heat from producers, operate the distribution system, and sell heat to end-users.

The district's heat distribution system consists of a central heat point, pump stations, a main pipeline, and distribution pipelines that supply heat to buildings. The system also includes individual heat points, where heat exchangers and water pumps are placed inside buildings.

[1] Remzhilzakazchik is a municipally-owned organization similar to public housing authorities in major U.S. cities.

Approach

The Metallurguichesky District project was designed as a model for district heating energy efficiency projects in Russia, and it is being used to understand the barriers facing such projects. The Russian participants in the Metallurguichesky District project were the Russian Center for Energy Efficiency (CENEf, a Russian non-governmental organization that developed the project), Chelyabinsk regional and district governments, and local on-site experts. The U.S. project participant was Battelle, Pacific Northwest National Laboratory (PNNL). The initial stages of the project were financed by PNNL under a contract with the U.S. Department of Energy. The project team started work in early 1996 with a series of energy audits, which were used to develop a feasibility study.

The project team considered several options for improving the reliability of heat supply in the district while preserving the peak capacity level at the Mechel co-generation plant. They also estimated the potential energy savings at the co-generation plant, central heating points, heat pipelines, public buildings, the Mechel housing development, and the Remzhilzakazchik housing development.

The project team made a number of specific recommendations to the city administration. They were as follows:

- introducing heat metering points at mains;
- automating control of gas combustion in boilers;
- installing adjustable speed drives at pump motors;
- using ultrasonic boiler cleaning;
- improving diagnostic techniques at pipelines and boilers;
- improving insulation in heat pipelines;
- replacing insulation in heat pipelines;
- replacing steel pipes with plastic pipes;
- constructing individual boiler houses;
- installing individual automated heating points;
- installing balancing valves;
- installing heat meters and regulators for customers; and
- installing heat mirrors and low-emissivity film for windows in apartments.

These recommendations and the accompanying business plans allowed the district to apply a number of modern energy-saving technologies without considerable up-front investment or extensive reconstruction of existing pipelines. The project team also developed variants that would accommodate lower or higher levels of investment. Table 1 provides an estimate of potential annual energy savings at different locations.

Table 1. Potential Annual Energy Savings in the Metallurguichesky District Heating System

Project Location	**Estimated Savings** (GJ)
The Co-Generation Plant at the Mechel Factory	456,000-630,000
Mechel Factory Housing Developments	934,000-1,281,000
Remzhilzakazchik Housing Developments	636,000-875,000
Public Buildings	151,000-218,000
Individual Boiler Houses	130,000-134,000
Heat Pipelines and Central Heating Points	558,000-564,000

The project team identified three sources of financing for the measures: 1) the Chelyabinsk municipal budget, 2) Remzhilzakazchik's funds for equipment repair and maintenance, and 3) loans. Project developers assumed in their calculations that project savings would exceed investments from the municipal budget for each year of operation. The project team did not assume that all of the energy-saving measures would be implemented. The team also developed four subprograms to be included in the business plan:

- a program to renovate central heating points and heat pipelines owned by Remzhilzakazchik;
- a program to improve heating efficiency in public buildings;
- a program to improve heating efficiency in the Remzhilzakazchik housing development; and
- a program to install individual boilerhouses on the roofs of three 9-story apartment buildings.

While each subprogram could be implemented independently, the integrated implementation of all four programs would provide the greatest benefits to the city. The project developers suggested that the Mechel factory pay for the energy-saving measures at its co-generation plant and its housing developments because the municipal efficiency project was designed primarily to reduce expenditures for the local government. Therefore, energy-saving measures identified at the sites owned by the factory were not considered in the final analysis.

Project Evaluation

Economic Effects

Total project costs were calculated by considering equipment, installation, and commissioning costs. If all measures for Remzhilzakazchik facilities and public buildings were included, approximate project costs would total $7.2 million. Dividing total project costs ($7 million) by the maximum net economic effect ($3.5 million) would yield a simple pay-back period of approximately 2 years. Unlike many investment projects, however, savings will always exceed municipal budgetary investments, so the net annual effect will always be positive.

Table 2. Structure of Project Financing (in U.S. dollars)

Year	Municipal Budget	Bank Loan	Remzhilzakazchik*	Total Investments
1997	700,000	400,000	500,000	1,600,000
1998	1,200,000	600,000	500,000	2,300,000
1999	1,000,000	0	500,000	1,500,000
2000	900,000	0	600,000	1,500,000
2001	0	0	300,000	300,000
2002	0	0	0	0
2003	0	0	0	0
Total	**3,800,000**	**1,000,000**	**2,400,000**	**7,200,000**

**Note:* Remzhilzakazchik's funds will be drawn from their budget for equipment repair and maintenance.

As Table 2 indicates, no new financing will be required after 2001, although annual savings at that point will have surpassed $3 million/year. Project-related savings are estimated at $4.5 million for the year 2003 alone. The economic effect for the entire project period (1997 to 2003) is estimated at $25 million. Net municipal budget savings would grow from $430,000 in 1997 to $3.5 million in 2003. Total net budget savings for the project would equal $16.8 million.

Table 3. Project Impact (in U.S. dollars)

Year	Total Savings	Debt Service	Additional Incentives for Employees	Investments to the Project from the Municipal Budget	Remzhilza-kazchik Net Savings	Municipal Budget Net Savings
1997	1,200,000	-200,000	50,000	800,000	200,000	400,000
1998	2,552,736	-200,000	75,000	1,200,000	400,000	1,100,000
1999	3,400,000	-200,000	75,000	900,000	500,000	2,000,000
2000	4,300,000	-50,000	75,000	900,000	700,000	2,700,000
2001	4,400,000	-50,000	75,000	0	900,000	3,600,000
2002	4,400,000	0	75,000	0	900,000	3,500,000
2003	4,400,000	0	75,000	0	900,000	3,500,000
Total	**25,000,000**	**-700,000**	**500,000**	**3,800,000**	**4,500,000**	**16,800,000**

The funds from the municipal budget are provided by a mechanism called a "subsidy shift." The city administration shifts a portion of money being spent to subsidize heat bills into the renovation program. The renovation in turn reduces heat consumption and decreases the amount of the subsidies the government must pay. Project developers also included a line item for additional incentives in project costs to motivate the staff of Remzhilzakazchik.

Table 4 provides the financial analysis for the program that is currently being implemented in Remzhilzakazchik housing developments.

Table 4. Measures Implemented in Remzhilzakazchik Housing Developments in 1997

Measures	Costs per Unit Installed ($)	Savings per Unit Installed ($)	Payback Period (no. of years)	Cumulative		
				Total Costs ($)	Total Savings ($)	Payback Period (years)
Individual heating points in buildings	148,500	222,500	1	148,500	222,500	1
Balancing valves in buildings	6,700	5,700	1	155,200	224,100	1
Heat meters for buildings	21,600	25,400	1	176,800	249,600	1
Insulation for hot water stand pipes in buildings	145,100	78,000	2	321,900	327,600	1
Faucets, shower heads, and hot water meters for apartments	224,100	197,500	1	546,000	525,100	1
Evaporative heat meters for apartments	40,300	-13,400		586,300	511,700	1
Radiator reflectors and heat mirrors in apartments	0	0	0	586,300	511,700	1
Cold water meters in apartments	85,100	36,900	2	671,400	548,000	1
Total	**671,400**	**552,600**	**1.3**	**3,192,400**	**3,120,900**	**1**

Project developers suggested that the installation of radiator reflectors and heat mirrors should be financed voluntarily by residents because these measures are relatively inexpensive ($90/apartment) and their pay-back period averages 2.4 years.

Three Remzhilzakazchik residential buildings are to be equipped with individual boilerhouses. Measures suggested for Remzhilzakazchik central heating points and heat pipelines involve retrofits using adjustable-speed drives at the pumping motors, sylphone compensators, pipe insulation, plastic pipes, mechanical filters with regeneration, and information systems. The project team recommended a similar set of measures for public buildings such as schools and nurseries.

Environmental and Climate-Related Effects

It would be premature to make any authoritative pronouncements about the environmental impact of the Metallurguichesky District project. However, the measures included in the Remzhilzakazchik component of the project alone are expected to result in annual reductions of 33,000 to 44,000 tons of carbon. Emissions of CH_4, CO, SO_2, and NO_x do not play a significant role in total emissions because the heat production systems use natural gas. The potential for savings in the Remzhilzakazchik component of the project is estimated at 1.1 million GJ to 4.4 million GJ of heat and 500,000 to 700,000 kWh of electricity. The estimates will be affected by the final mix of efficiency measures for subsequent years.

The economic benefits of the project include total savings of $21.3 million, including savings of $4.4 million for Remzhilzakazchik over the 1997 to 2003 period. Net savings to the municipal budget will reach $16.8 million. As mentioned, budget expenditures on the project will be outweighed by the savings from reducing the burden of heat and hot water subsidies to housing estates, schools, and health care facilities. In addition, these savings will extend to households. Monthly bills for heat and all types of water for families in the district will be approximately 29 percent lower in 2003 than in 1997.

If implemented, the project will allow the local government in Chelyabinsk to accomplish the following:

- improve the municipal budget by considerably reducing or eliminating heat subsidies and encourage a rapid transition to full payment of heat bills by residents;
- direct budget funds to critical social safety net programs;
- improve heat generation, distribution, end-use efficiency, and comfort in apartments;
- reduce the number of accidents in district heating and the claims by residents of poor quality of heat supply services;
- reduce the burden of heat bills for residents, even as their bills begin to cover the full cost of the heat;
- ease the nonpayment problem, reduce municipal debt due to heat subsidies, and reduce heat utility debt due to high fuel bills;
- reduce carbon emissions related to heat generation; and
- improve air quality and comfort in buildings served by the district heating systems.

The renovations will also provide a steady supply of heat, which is critical for cities with extreme climates. The heating season in Chelyabinsk lasts more than 218 days. Temperatures for the entire heating season average 19°F, and in January they drop to -26°F. A reliable heat supply in Chelyabinsk can be literally a life or death matter.

The project will also provide spillover benefits to the residents of Chelyabinsk. The local government will be able to use the money it saves in the heating sector to address chronically underfunded public services such as education and health care. The burden of paying for these types of social services has fallen on regional and local governments. Improving efficiency for institutional energy users, such as schools and hospitals, will free funding for renovations, new equipment, and efforts to increase the quality of services. Salaries of teachers, doctors, and other employees on the Chelyabinsk payroll are among the lowest in Russia, but budgetary savings could be used to raise those salaries to the national average.

City and regional governments have also been forced to increase transfer payments to residents, because unemployment and poverty have skyrocketed. Pensions and disability benefits are too low to support an acceptable standard of living for their recipients and they are not paid on time. Improving the efficiency of the district heating system will result in three important improvements in the social safety net of Chelyabinsk: 1) an immediate reduction in the sum of money spent by the local government for heat subsidies, 2) an opportunity to phase out heat subsidies to households earlier, and 3) a reduction in the number of people below the poverty line, as more families receive utility bills totaling less than 15 percent of their income.

Barriers to Implementation

Major barriers to implementation include a lack of statistical data on the heat supply system, the reluctance of the organizations involved to apply new technologies, and a lack of expertise among system staff in business planning and project development in a market environment.

The first stages of the project were important because they demonstrated that real prospects for district heating improvement projects exist even under current economic conditions. The initial steps also demonstrated the importance of expert financial analysis. A third important factor was training for the project participants, including the local officials who approved the project and the on-site managers of the heating systems, who are overseeing management of the improved system. Because the situation in Metallurguichesky District is typical of that in many large Russian cities, training for the employees of heat supply companies and local governments would be necessary to replicate energy efficiency programs in other locations.

One of CENEf's main tasks as a project developer was to create financing plans that varied by source of capital and equity, allocation of costs and benefits, scope, and time frame. All variants proposed financing mechanisms in which annual budget expenditures on the project were less than annual savings for any given year. This structure made the project attractive to potential investors, particularly local officials.

How The Project Could Be Expanded

The Metallurguichesky District project is now in its primary stages. After implementing energy efficiency measures for residential customers, it will be possible to expand investments to cover supply-side measures.

The Chelyabinsk project has already become a blueprint for officials in other cities who are interested in implementing and financing energy efficiency measures. The project could serve as a model for many other projects to improve the energy efficiency of district heating systems, generate social and economic benefits by reducing subsidies, introduce market mechanisms, and realize other positive effects.

More than 40 percent of all fuel currently consumed in Russia is used to produce heat. Therefore, district heating plays a critical role in Russia's energy balance. Almost half of all heat produced is intended to supply municipalities. Efficiency in this sector, however, is among the lowest in Russia. For these reasons, improving the efficiency of district heating has the potential to be a major source of energy conservation and GHG emissions reduction in Russia.

District heating systems in Russian cities with populations greater than 10,000 have a nearly identical layout and are in approximately the same condition as those in the Metallurguichesky District. These systems consume a total of about 450 to 500 million Gcals each year. In Table 5, the population structure of Russian cities in 1994 gives a better idea of the scale on which this project could be replicated.

Table 5. Population Distribution in Russian Cities, 1994

Urban Population	Number of Cities
10,000-20,000	254
20,000-50,000	361
50,000-100,000	171
100,000-500,000	136
500,000-1,000,000	21
over 1,000,000	12

The Metallurguichesky District project could be applied to centralized systems in any city with a population under 250,000, or in individual districts of larger cities. If financing were available, more than 1,000 similar projects could be implemented in Russia, with potential annual energy savings of 190 to 250 million GJ.

All of these projects could be cost-effective, with payback periods of no more than 3 to 5 years. The projects could also serve as a negative cost climate mitigation option because the full range of projects would provide cost-effective reductions of up to 10 to 20 percent of current GHG emissions, or 6 to 8 million tons of carbon.

Currently, 25 to 45 percent of municipal budgets in Russia must be spent on heat subsidies. District heating efficiency projects could reduce this percentage by half, making it possible to use saved money for local social programs. For example, savings could be used to improve education and healthcare because these public services are also financed from municipal budgets. However, any plan to bring this type of project to other Russian cities regions will have to contend with three serious obstacles that lie outside the realm of energy efficiency: a depressed economy, municipal budget shortfalls due to nonpayment at the regional level, and regional governments lacking information and experience with this type of project.

Case Study 2: An Industrial Energy Efficiency Program at the "Moscabelmet" Company

Background

Energy efficiency plays an important role in the economic health of any industrial enterprise. This role has increased recently in Russian enterprises as a result of economic instability and the permanent growth of energy prices. Moscabelmet is one of the largest manufacturers of aluminum and copper cables and wires in Russia, employing 1,500 workers. The energy-intensive nature of Moscabelmet's work means that annual power consumption at the plant reaches 55 million kWh and heat consumption can be as high as 540,000 GJ. As a result of fuel price increases and production inefficiencies, the share of energy costs as a percentage of total production costs at Moscabelmet has grown from 2 to 5 percent in 1993 to 15 to 20 percent in 1995.

Moscabelmet began to develop and implement measures to improve energy efficiency 8 years ago under the initiative of its CEO. The program is funded from Moscabelmet's own financial resources and has four objectives: 1) improve product competitiveness; 2) reduce vulnerability to energy price changes; 3) reduce dependence on supplies from Moscow's electric and water utilities; and 4) enable Moscabelmet to survive Russia's macroeconomic crisis.

Approach

Moscabelmet first created a complex information system designed to cover all of its energy facilities. It then launched two major energy-saving programs: an energy monitoring system and an energy management system.

Moscabelmet's energy monitoring system first introduced metering and automated controls for energy use in all industrial processes, shops, and services. As a first step in this direction, Moscabelmet purchased IISE-2M and IPSE-3 electric power metering systems in 1991. In 1992, the company signed a contract with Gamma, a Hungarian company, for the delivery of a heat/energy control system for cold water, steam, gas, and hot water. In 1993, an Electric Power Technical Control System based on the IISE-2M complex was put into operation. The system collects and stores data on power consumption by plant department and by the most energy-intensive aggregates. Plant substations now feature 150 electric meters with telemetric output. The information collected is processed at a central station. The Heat Control Automation System, also installed in 1993, has provided heat consumption accounting for both individual shops and the plant as a whole since its installation.

The data collection and processing system at Moscabelmet includes primary consumption meters, pressure temperature sensors, and 11 microprocessors that receive information and perform local management. These components are connected to one other and to the master station. Control points are checked every second, and the corresponding signals are processed every 1 to 15 seconds. In addition, the system allows technicians to perform visual control of technological parameters. As of late 1996, controls for cold water appliances were essentially complete, and steam and hot water consumption sensors were almost all on line.

To improve the reliability of electric energy supply, dispatching points for transformer substations were included in the modifications. This system allows personnel to control the 10 kV energy supply systems and make changes when necessary. Up to 100 signals are linked to the signal system, including the condition of oil switches, voltage control at substations, and reserve power supply cables. Installation of the system at the substations is currently underway. A switchboard has been produced and installed, and the alarm system is working at four out of eight substations. Reliability is a concern for the plant; there have been several recent voltage drops and cable disconnections that were the fault of the Moscow energy utility. As a result, Moscabelmet suffered considerable losses from production stoppages.

The plant also plans to automate voltage and frequency control at each electrical substation to reduce the duration and magnitude of voltage drops and reductions. A digital voltmeter/frequency meter with remote data transmission has already been developed and manufactured. The plant's transforming substations will be supplied with this equipment to relay data to the IISE-3 complex, which has been upgraded for this purpose.

As a result of these programs, the plant now has four automation systems that are either in place or in the process of being installed. The systems are a hybrid of domestic and imported technologies, and they allow Moscabelmet to control energy use throughout the plant. Energy analysts are able to group initial data by any factor (e.g., shop, aggregates), compile daily and monthly consumption diagrams, view the diagrams on a monitor, and print them out. As the number functions of the information system increase, new modules can be attached.

Moscabelmet's Integrated Program of Rational Energy Use focuses on implementing measures to reduce the consumption of water, hot water, and steam. In several shops, the internal water supply system has been upgraded, reducing annual water consumption by 42 percent between 1994 and 1995. The heating system at the plant has also been upgraded by installing heat elevators, steam traps, temperature regulators, and other equipment. Moscabelmet expects to reduce energy consumption by 20 percent at each unit by installing steam traps produced by Armstrong, an U.S. company.

All of the above measures were financed from Moscabelmet's internal resources. The only external assistance received by Moscabelmet was a series of energy audits that were performed by foreign companies.

Program Evaluation

A preliminary cost estimate for the integrated energy efficiency program was set at between $100,000 and $160,000. Annual cost savings have been estimated at $90,000, so the pay-back period for the program is under two years. Moscabelmet has spent about 5 to 7 percent of its annual revenues on the program in the past several years. The company has made several attempts to obtain external financing or technical assistance in the form of equipment, but they continue to be limited to internal funding sources.

Moscabelmet is a mid-size Russian industrial enterprise. It differs from similar companies mainly in its sophisticated, market-oriented management. This management has allowed Moscabelmet to survive a difficult transitional economic period without dramatic declines in production.

These dramatic economic changes have made it difficult to evaluate the economic and environmental benefits of the Moscabelmet program. Past economic baselines are not particularly useful in an evaluation because they have almost nothing in common with current trends. The dramatic changes in the Russian economy have made it impossible to develop a "business as usual" scenario. Future scenarios are also not particularly useful; they are not sufficiently well-defined.

Economic Benefits

The following substantial improvements are indisputable: 1) peak load at the plant was reduced by changing production processes and job schedules in some shops, 2) water waste from production stoppages was eliminated, 3) hot water use was optimized by installing return water temperature controls; and drinking water use was reduced by introducing daily controls. Moscabelmet is taking its next step by installing a monitoring system for particular shops and products to control energy intensity and motivate staff to use energy more efficiently.

The primary economic result of the program has been Moscabelmet's stable economic situation in the midst of flux in the Russian market. Moscabelmet owes no back taxes and has no debts to energy and water suppliers. Although output levels fluctuate more than in the past, there has been no dramatic decline in production. Furthermore, there has not been a significant reduction in the number of jobs at Moscabelmet over the past 2 years, and wages have been paid on time despite a nonpayment crisis in the country. Moscabelmet's management has an enviable track record; few other Russian enterprises can make similar claims.

Environmental and Climate Benefits

Emissions reductions have occurred indirectly as the result of reducing annual consumption of all energy sources at the plant. Table 6 lists reductions for the years 1994 and 1995, not including reductions due to decreases in water consumption. The resultant figure of 4,800 tons of carbon for 1995 therefore underestimates total reductions.

Table 6. Energy and Emissions Benefits of the Moscabelmet Program

	Consumption in 1994	Consumption in 1995	Reduction (%)	Emissions Reduction (tons of carbon)
Power, million kWh	55	51	9	1,000
Potable Water, 1,000 m^3	650	500	23	--
Steam, 1,000 GJ	420	330	20	3,200
Hot Water, 1,000 GJ	110	90	20	600

Reductions in resource use at the plant have had other environmental benefits. For example, significant reductions in potable water consumption have reduced waste water discharge. There have also been institutional benefits to the program. Moscabelmet's experience in reducing costs through a major efficiency initiative has been beneficial to the plant, and it has allowed Moscabelmet to serve as a role model for other plants seeking to reduce costs.

How This Project Could Be Expanded

The Moscabelmet project is already serving as a model for programs at other Russian enterprises. The company's industrial efficiency program has been presented at a number of energy efficiency meetings in Russia and written up in several publications. More than 1,000 viable industrial enterprises exist in Russia that consume more energy than Moscabelmet and have an internal energy use profile at least as complex as that of Moscabelmet. Almost none of these enterprises monitor or control their energy use. Implementing similar systems at these enterprises would be cost-effective and would also result in no-cost GHG emissions reductions.

Most Russian industrial enterprises with more than 1,000 employees and diversified energy-using equipment have their own energy management service. This service usually includes several engineers and technicians who operate all of the equipment fueled by electric power, heat and gas. The energy management service is also responsible for energy supply, use, and efficiency at the enterprise. Moscabelmet's approach to improving energy efficiency could serve as a model for energy efficiency initiatives at many other industrial enterprises.

Ideally, similar projects should include the same stages as the Moscabelmet initiative:

1. Conduct an energy audit;
2. Develop and implement an energy monitoring system;
3. Restructure the enterprise's energy system on the basis of the findings;
4. Change operating regimes and/or install more efficient devices; and
5. Introduce automated energy control.

In the face of Russia's current economic difficulties, Moscabelmet's step-by-step approach is the most feasible option for industrial enterprises. Monitoring energy usage for particular shops and particular technologies should be a first step in improvements. Fortunately, monitoring equipment and software are universally available. Concrete changes in job schedules and equipment upgrades will, of course, depend on the specific enterprise. All plants, however, should consider introducing an automated energy control system for the entire production line as a final measure.

Barriers to Expansion

A lack of funding has been the main barrier to implementing all of the measures that Moscabelmet planned. The company has received no tax or other regulatory incentives from city or federal governments for its energy savings program, despite a significant reduction in burdens on Moscow's electric and water utilities. While Moscabelmet has been able to provide a certain amount of funding, its initial experience has made it clear that internal financing is insufficient to expand its energy savings program. Moscabelmet particularly needs assistance with identifying potential investors, developing project finance proposals, and applying for loans.

Financial barriers, lack of experience, and an absence of government incentives will all have to be addressed before implementing similar industrial projects on a larger scale. Technical assistance for Russian industrial enterprises that would like to develop similar projects, such as energy audits or business plan training, will be critical to overcoming existing barriers.

However, the potential payoffs from industrial energy efficiency are tremendous. Many industrial enterprises in Eastern Europe and the New Independent States could improve efficiency and reduce GHG emissions by installing modern meters and controls. The energy resources and raw materials saved by these enterprises could boost environmental quality and enhance market competitiveness throughout the transition economies.

Case Study 3:
An Energy Efficiency Bulletin

Background

Many regional governments see energy costs growing as a share of their budgets but do not know how to respond. A lack of experience with market pricing in the energy sector and a shortage of information about what is being done in other regions have slowed program development and hindered effectiveness. Without outside knowledge, program managers have no way of selecting the most effective options at the planning stage or of learning from success and failures in other regions.

The information shortage also extends to new technologies. The Russian market for energy efficient equipment has been changing rapidly during the past several years, but information on new products and services is limited. Decision-makers are also constrained by a lack of detailed information on energy consumption and losses in particular technologies. As a result, program evaluation has been very difficult.

Informational barriers have been no less important than their financial or technical counterparts in introducing energy efficiency to Russia's fledgling market economy. One of the most important mechanisms to overcome these barriers has been the use of publications to disseminate information about energy efficiency.

Approach

In the autumn of 1993, the Russian Center for Energy Efficiency (CENEf) launched *Energy Efficiency*, the first Russian periodical dedicated to energy efficiency. *Energy Efficiency* is a quarterly bulletin comprised of seven sections: energy efficiency policy news, new technologies and projects, introduction of potential partners, statistics, reviews, upcoming events, and other information.

CENEf has been able to publish *Energy Efficiency* because of ongoing grants from The John D. and Catherine T. MacArthur Foundation. The bulletin receives no support from the Russian federal government.

Currently, 1,200 copies of the bulletin are published in Russian--more than double the print run of the inaugural issue. *Energy Efficiency* subscribers in Russia include the federal government, regional energy commissions, regional utilities (heat and power), all Russian energy centers and agencies, and research institutes. Readership is higher than the circulation statistics for *Energy Efficiency* imply because, for each institutional subscriber in Russia, several people actually read the bulletin. In addition, 350 copies are translated and published in English. *Energy Efficiency* is distributed free of charge to Russia, other New Independent States, the United States, Western Europe, India, China, and other countries.   It has also been widely available at domestic and international meetings dealing with energy efficiency and climate change.

Energy Efficiency informs readers of each new federal law, other important regulatory documents, programs concerning energy efficiency, and regional energy efficiency experiences. Articles with a regional focus examine the development of regional regulations; programs and projects; and the establishment of special institutions, funds, and economic mechanisms to promote efficiency. In particular, the bulletin has followed the development of the Moscow program on energy conservation from its first issue.

Many types of technologies and equipment have been introduced to a Russian audience in *Energy Efficiency*, including Western metering equipment, controls and automated control systems for district heating, efficient gas burners and turbines, and steam traps. Financial mechanisms are also urgently needed in Russia, so the bulletin was also the first to describe and explain revolving funds, performance contracting, and energy service companies (ESCOs).

Information on international programs and projects, including primary participants, project objectives and tasks, is also published in *Energy Efficiency*. For example, the bulletin has covered the development and implementation of an international integrated resource planning (IRP) project in the Russian energy sector. Other coverage has featured the World Bank's Enterprise Housing Divestiture Project.

The "Potential Partners" section of *Energy Efficiency* has been an especially source of reliable information for both Russian and Western readers. Western companies are frequently unfamiliar with the business environment in Russia, and Russian customers have little information on foreign producers. The partners section, therefore, promotes business activity between the two groups. Both audiences benefit from the energy and economic statistics and other updates that are published regularly in the bulletin.

Project Evaluation:

Most of the editorial, organizational, and administrative activities for *Energy Efficiency* are performed by one CENEf staff member devoting 20 hours per week to the project.   However, the entire CENEf staff participates in the production of *Energy Efficiency* in some form. In nearly every issue, one or two articles written by staff are devoted to CENEf projects.

Program Costs

Four part-time employees are in charge of editing, translating into English, layout, printing, and distributing the bulletin. Some production tasks are contracted out to two specialized firms. Annual costs for CENEf to produce and distribute the Russian and English versions of *Energy Efficiency* total approximately $30,000.

Program Benefits

Environmental, economic, and climate benefits from the bulletin are difficult to quantify because *Energy Efficiency* is an indirect means of influencing policies and behavioral patterns. However, there are several clear indications that the bulletin has become an influential tool for shaping investment and policy in many different sectors of the economy.

Between three and five *Energy Efficiency* readers contact the editor at CENEf every day. Readers ask for more detailed information on published papers, particular technologies, specific projects, or legal issues. CENEf staff provide readers with additional information, such as the specific producers and suppliers of a certain type of equipment and its terms of delivery.

Often, readers from different Russian regions have decided to establish contacts with CENEf and/or launch an energy efficiency project after reading *Energy Efficiency*. The bulletin is also seen as an important venue for Western products. Manufacturers of energy-efficient equipment from Sweden, Denmark, Finland, Germany, and other countries have placed information about their technologies and services in the Bulletin.

Energy Efficiency has also been an important tool for influencing policy. Energy sector decision-makers often use the information from the bulletin in their work. For example, CENEf developed a draft of the "Law on Energy Efficiency" that was published in an issue of *Energy Efficiency*. This draft law was then used as a model for regional regulations in the Tula and Chelyabinsk regions. Information on efficient building codes developed for Moscow initiated similar developments in several regions, leading to the implementation of new construction technologies and the creation of new markets. *Energy Efficiency* has also provided Russian regions with an opportunity to exchange experiences with energy efficiency programs and mechanisms during the current economic transition. Copies of the bulletin were distributed to participants in nine regional energy efficiency seminars organized by CENEf in 1995 and 1996.

The English version of *Energy Efficiency* has also proved to be popular with its readers. CENEf recently placed issues on its Internet web site, and it has registered more than 1,000 visits to the site each month.

Nearly all Russian policy-makers who influence energy efficiency policy in Russia read and contribute articles to *Energy Efficiency*. Approximately 100 copies are distributed to key federal officials and institutions. Vitalii Bushuev, the Deputy Minister for Fuel and Energy, has published several articles on governmental energy policy in the bulletin. The head of the State Energy Inspectorate, experts in the Energy Department of the Ministry of Economy who are responsible for energy efficiency policy, and members of the Industrial Committee of the Russian parliament also receive *Energy Efficiency*. At the regional level, the bulletin is supplied to regional energy commissions and the heads of energy departments in regional governments (100 copies).

The rest of *Energy Efficiency*'s readership can be classified as follows:

- regional power supply companies and energy inspectorates (200 copies)
- staff of district heating companies, at the special request of the Russian Association for District Heating (200+ copies)
- chief energy managers of industrial enterprises (100 copies)
- experts at research institutes, design and engineering companies, and energy-efficient equipment manufacturers in Russia and other NIS countries (200 copies)
- representatives of foreign companies that supply energy-efficient technologies and services to the Russian market (50 copies), representing most companies in this market segment energy efficiency centers and funds all over Russia (20 copies)
- public and non-governmental organizations and individuals such as the Socio-Ecological Union, universities, and independent experts (50 copies)

<u>Climate-Related Benefits</u>

In addition to covering energy issues, the bulletin has also educated its readers about domestic and international activities under the United Nations FCCC. *Energy Efficiency* is one of only a few venues that illustrate the link between economic policy, energy policy, and climate policy.

Energy Efficiency's diverse readership gives it another advantage. It reaches certain groups of readers, such as Russian entrepreneurs and regional policy-makers, who would not ordinarily receive climate policy information.

<u>How This Project Could Be Expanded</u>

Energy Efficiency has already been used as a model for similar publications in the Moscow region, other Russian regions, and Ukraine. The project could continue to be expanded 2 ways:

1. The number of copies distributed could be increased. In addition, Russian and English-language copies could be distributed to energy policy-makers and investors throughout the New Independent States.

2. Additional publications for special market segments could be developed. The publication of *Energy Manager*, a quarterly bulletin available only in Russian, began this year as an offshoot project. The new periodical is published mainly for senior energy managers of industrial enterprises.

A shortage of information on energy efficiency and practical approaches and mechanisms to improve it cannot be overcome by a single periodical. Different audiences need specific publications in a language that is understandable to them. Therefore, various types of materials are needed, ranging from theoretical research reports to pocket-size guides. More basic research reports, case studies, and manuals, in conjunction with training courses and workshops, would be a reasonable step towards bringing information on energy efficiency to decision-makers who can then enact positive changes.

Conclusion

Comment by Sergei Avdiushin [2]

Three revealing examples were presented above. It is possible to continue this list of examples to show various possibilities of improving energy efficiency on a regional or local basis. Among a great number of factors which determine the dynamics of energy efficiency in Russian regions, it is necessary to note the degree of interest of regional authorities in the problem of energy savings.

There is a practice in the Russian Federation of signing bilateral agreements between appropriate federal ministries or agencies and subjects of the Russian Federation (regions). This practice already exists in the Ministry of Fuel and Energy in the field of energy saving, and in Roshydromet for traditional hydrometeorological services. Now a precedent for this type of cooperation has been set by the Interagency Commission of the Russian Federation on Climate Change Problems and regional authorities of Nenetsky National District (an oil- and gas-producing region in the European North of the Russian Federation). The commission and the regional authorities have exchanged letters of intent to cooperate in the field of energy efficiency in the town of Naryan-Mar, at oil and gas mining enterprises, and with adaptation assessments including a joint implementation approach.

Under the agreements signed by the Ministry of Fuel and Energy and the subjects of the Russian Federation in 1995, the following work was carried out:

- Legislative regulations and standards for an organizational financial basis for energy savings were ratified in seven regions of the Russian Federation (St.Petersburg, Tula, Chelyabinsk, Tomsk, Kemerovsk, Novosibirsk, and the city of Moscow, which is its own region).
- Energy savings funds were established in four regions of the Russian Federation (Nizhny Novgorod, Chelyabinsk, Tula, and the city of Moscow). These funds provide about $2.6 million annually for projects that save about $3.3 to $3.5 million (or 34 to 42 PJ in saved fuel) by enabling factories and energy producers to purchase and install metering equipment;
- Ten energy-efficiency demonstration zones were organized in three regions (the city of Moscow, the Moscow region, and the Nizhny Novgorod region) with total potential energy savings of up to 42 PJ.

In 1995, about $17 million was spent on energy-saving initiatives in the Russian Federation from all sources, resulting in about 335 PJ of savings. The majority of available financing was directed at establishing new production capacity for the manufacture of heat and water meters, as well as

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[2] Sergei Avdiushin is the Deputy Chief of the Russian State Committee on Hydrometeorology.

gas meters for residential customers. These measures should allow heat consumers to reduce their bills by 15 to 30 percent and provide a pay-back period for installation costs of less than 1 year.

Recognizing the positive experiences gained by governments and private organizations at federal, regional, and local levels, and acknowledging existing barriers, we would like to present further developments and perspectives in implementing a federal target program, “Prevention of Dangerous Climate Changes and their Negative Consequences.” We have a strong desire to announce this new federal initiative and believe that its successful implementation will assist other developments aimed at meeting the goals of the United Nations FCCC in national, regional and local energy efficiency improvement.

The main purposes of federal target program (coordinated with the Environmentally Sound Energy program and others) include the following elements:

- the development and mastery of technologies, facilities, equipment, and materials to provide a radical reduction in GHG emissions;
- energy savings;
- a reduction in the negative influence of extracting and producing primary energy resources on the environment;
- the processing, concentration, transportation, storage and use primary energy resources;
- improvements in the safety of power production;
- a reduction of losses in the fuel and energy complex that are unrelated to production;
- an increase in the efficiency of the fuel and energy complex; and
- the creation of conditions for introducing new energy sources and methods of utilization.

The program is open to the inclusion of new important directions and projects, including cost-effective foreign investments that are environmentally sound globally. In addition to a large number of state enterprises, associations, and design and research institutes, a broad and ever-growing range of commercial firms are taking part in activities connected with the implementation of Russia’s commitments under the FCCC. Participation in the program is also open to interested foreign companies and scientific institutions.

A trend in most countries is to expand electrification in all branches of the economy, including the household sector. Global power industry forecasts developed by the World Energy Council and other international organizations envisage a higher rate of growth in electricity consumption in comparison with the overall rate for primary energy. This situation is caused by a number of factors, the most important of which is the high degree of acceptance of electricity by consumers, due to its cleanliness, the relative simplicity of transmission over long distances in almost any quantity, and the possibility of improving the quality of many types of goods if production technologies are converted from combustion processes to electric power (total electric power generation in Russia in the year 2000 is estimated at approximately 1,200 TWh, growing to 1,400 to 1,500 TWh by the year 2010).

Initially, the share of thermal power stations in total electricity production in Russia will remain practically unchanged compared to present levels (about 70 to 80 percent) or may increase slightly.

When the ways to meet Russia's growing demand for electricity are being determined, it will be necessary to consider the potential in different fuel industry branches and their resource base. The explored reserves of fossil fuels (first and foremost oil and gas) which provide more than half of all electricity generated, are not infinite. The most efficient of these fuels is quickly being depleted. The cost of exploring and developing new oil and gas fields is growing each year. The capital investments that allow growth in the production capacity of oil extraction are increasing at an even greater rate. The tense ecological situation in Russia and the Russian and world public's concern about the possible negative consequences for the climate from growing fossil fuel consumption in power plants should also be considered.

Today one way to reduce the scale of CO_2 emissions in the atmosphere is to restrain the growth rate of fossil fuel consumption or even reduce the total amount consumed, primarily by increasing the efficiency of its use. Restraining the growth rate of CO_2 emissions in the atmosphere may also be furthered by increasing the share of the natural gas combustion because the emission of CO_2 per gigajoule of energy produced is considerably lower in comparison to coal or oil. The state of the Russian oil industry does not make it possible to increase mazut-based electric power generation in the future.[3] Moreover, the task is to reduce sharply the quantity of mazut burned at power stations in the near future and bring consumption down to the minimum amount required by existing technology. In another 15 to 20 years, similar requirements could also appear for natural gas used at power stations.

To provide a reliable, effective, environmentally clean, and safe supply of power with long-term prospects, it is necessary to implement several measures in advance, including

- improving the fuel and power balance structure by increasing the share of hydropower and the other renewable energy sources, natural gas, and technologies that minimize pollution as the result of fossil fuel combustion;
- increasing energy efficiency in all sectors of the economy through economic restructuring programs that promote an increase in the share of high technology and minimize energy-intensive production;
- extending the use of existing energy-saving technologies and techniques and developing and introducing new ones;
- improving legislative and regulatory mechanisms that employ market signals to influence energy consumption and conservation;

[3] Mazut is a liquid residue from petroleum distillation that is used in Russia for fuel oil.

- developing and introducing new environmentally clean and safe technologies to the Russian economy, beginning with energy-intensive sectors such as the fuel and energy complex; and
- increasing efficiency in the process of transforming fuel and energy resources into heat and electricity with combined cycle production technologies and wasteless technologies.

Further developments should be aimed at reducing the negative influence of practically every part of the fuel and energy complex on the environment. These measures should include environmentally clean thermal power plants run on solid fuel; environmentally sound coal enterprises and fossil fuel processing enterprises; and the production, transportation, and use of water-coal suspension. In addition to nontraditional energy resources, direct energy savings could be realized by using heat pumps or other technological solutions.

Energy efficiency improvements should also be instituted in industry, the municipal sector, and households because an integrated approach is required to realize the mosaic of potential improvements and success will benefit human society and the environment.

International Aspects

Interest exists in international cooperation between the Russian Federation and western countries in the field of energy efficiency, as well in all FCCC-related activities.

It is well known that Russia has been unable to achieve a favorable climate for western private investment in energy efficiency and energy savings. Most investment received by the Russian Federation during the past several years has come from western governments or international financial institutions such as the World Bank.

Creating possibilities for private investment is one of the primary tasks of the Russian country team working on climate change problems. We realize that additional mechanisms for technology transfer need to be created. We hope that the Organization for Economic Cooperation and Development (OECD) Tranche 2 study, "Financial Mechanisms for Energy Efficiency in Countries in Transition," will provide a set of findings to help overcome existing barriers.

Joint implementation also has the potential to replicate successful projects, including those in energy efficiency and conservation. However, in the framework of the pilot phase of Activities Implemented Jointly (AIJ), the results have been too premature to affect the current situation concerning GHG mitigation and reduction in any significant way.

The idea of carbon trading appeared again at the most recent negotiations of the Russian team with international partners. This idea looks very attractive. If adequate carbon trading mechanisms were found that would be attractive both to investors and host countries, and if the international community made the necessary decisions regarding the adoption of a trading regime, a trading mechanism could stimulate improvements, reduce the costs of GHG mitigation, and benefit participants.

Regarding U.S.-Russian cooperation in the field of limiting and reducing GHG emissions, it is necessary to keep in mind that in July 1996 the two governments signed a political statement of intent in this field. Activities since then have occurred at a governmental level and at various levels of cooperation between private companies, research institutes, and other organizations interested in developing implementation mechanisms.

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Appendix: Summary of Potential Mitigation Measures in Russia [4]

Category	**Fuel savings** (million tons of coal equivalent)	**GHG reductions** (million tons of carbon)
POWER GENERATION	**73-89**	**44-53**
Commissioning of fuel-saving steam turbines	12-14	7-8
Installation of gas turbines at existing thermal plants and boilers	50-60	30-36
Better turbine loading	4-5	3-4
Introduction of major boilers employing fluidized bed furnaces	6-8	5-7
HEAT SUPPLY	**35-40**	**20-24**
Reduction of heat losses via better heat pipeline quality, and improvement of hydraulic and thermal insulation materials		
OIL INDUSTRY	**10-13**	**6-8**
Wider use of associated petroleum gas and gas condensate	6-8	4-5
Pump upgrades, and use of SCR-driven power supplies	1	1
GAS INDUSTRY	**22-25**	**13-15**
Replacement of existing compressor units by those with better fuel efficiency	12-14	7-8
Switching to steam/gas schemes for compressor stations (added savings)	9	6
COAL INDUSTRY	**3-4**	**2-3**
Use of mine methane for power and heat generation		
REFINING		
Innovative technologies for energy- intensive processes	**11-14**	**9-10**
(upgrading furnaces, use of specialty catalysts, etc.)	5-6	4
Reduction of excessive crude and product losses	6-8	5-6
TOTAL:	**150-180**	**90-110**

[4] Source: Millhone, 1997.