Energy Efficiency

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Published in *The New Russia: Transition Gone Awry,* Lawrence Klein and Marshall Pomer, eds. (Stanford University Press, 2001), pp. 365-378.

Higher energy prices, lower subsidies, and privatization should have resulted in more efficient energy use in Russia. But enterprises and households have not been responsive to vast and profitable opportunities to improve energy efficiency. Without support and initiative from governments at municipal, regional and federal levels, responses to market incentives may take decades. In the meantime, many enterprises, households, and municipal governments are overwhelmed by high energy costs. The situation in the residential sector has changed little since 1992. In industry, some larger enterprises had finally begun to finance energy efficiency improvements by 1998, but the macroeconomic turmoil of late 1998 put a halt to these types of investments.

This chapter examines the role of government in improving energy efficiency in both the industrial and residential sectors. Among the important issues it considers are physical infrastructure for energy metering, legal and financial institutions, strengthened managerial and regulatory skills, and government support for market intermediation.

Industry

Typical energy intensities in Russian industry were 20 to 100 percent higher than in Western countries in 1990, and the gap has increased since then (Cooper and Schipper 1992; IEA 1995). Inefficient energy use resulted from well-known features of the former Soviet system: enterprise managers lacked incentives to minimize costs and to innovate; energy was often wasted, or even dumped, to maintain future allocations; and design institutes were separated from production, inhibiting technological advance (Nove 1986). In addition, energy was priced extremely low.

A wide variety of energy efficiency improvements could drastically lower energy intensities (Office of Technology Assessment 1993; Kogan 1993; Evans 1996). Some of these improvements require replacement of entire production processes. For example, for the steel industry to be competitive, steel-rolling must be replaced with the more efficient process of continuous casting. In 1991 the latter produced only 20 percent of steel output, compared with 90 percent or more in other countries, including Japan. Ironically, the Soviet Union invented this technology and licensed it to Japan, where diffusion was rapid (Cooper, 1991).

Other gains in energy efficiency can be achieved through small incremental investments. Examples include better accounting and management of energy flows, automatic thermostats, secondary process-heat recovery, reduction of steam and pressurized air leakages, better heat-pipe insulation, improved boiler combustion controls and boiler tuning, lighting-control equipment, and addition of variable-speed drives to motors. The technologies involved pose no problems for Russian engineers. And these investments can be very profitable; payback times range from a few months to a few years for most investments.

To take advantage of these opportunities, managers must think in cost-minimizing terms, analyze investment returns, and borrow capital. Managers also need to learn how to present investment proposals and business plans to financial institutions. But Soviet managers were unfamiliar with the concepts of cost-of-capital and rate-of-return because capital was allocated on the basis of planning and political priorities. Moreover, the capacity for creative, independent thinking was suppressed in the Soviet era since managers followed plans dictated from above. Interviews and case studies corroborate the importance of fostering ?new mentalities? among enterprise managers (Martinot 1995; Evans and Legro 1997).

Inexperience related to business planning, cost-minimization, innovation, and finance are compounded by lack of information regarding costs and benefits of energy efficiency measures. In the West, cost estimation is a mature field with many established databases from which to draw. In Russia, there is little historical experience on which to base cost estimates. In the Soviet era, information was centralized among authorities in Moscow, and enterprise managers did not directly contact foreign suppliers. Informal information networks now operate through personal contacts. Cost savings are difficult to judge because unmetered heat consumption and a lack of energy accounting practices obscure energy consumption baselines.

Many enterprises could invest in cogeneration to become independent power producers. Energy costs from cogeneration using combined-cycle gas turbines can be significantly less than the costs of purchased energy. A federal law allowing independent power producers to operate and sell surplus power back into the electric system was adopted in 1996. But practical implementation of the law?including the proper legal framework, regulatory oversight by regional energy commissions, and contractual models?has yet to be developed. Inadequate oversight means that utilities wield considerable power. One enterprise that wanted to install a combined-cycle gas turbine was threatened with being cut off from the electricity grid by the Moscow power utility (Martinot 1995).

Similarly, inefficient heat production can result from a lack of appropriate regulation at the municipal level. Many enterprises find it cheaper to produce their own heat than to purchase heat from a common municipal network. Conversely, existing industrial boilers may be less efficient than municipal utility boilers, but continue to operate because enterprises cannot purchase network heat. Uncoordinated heat-supply expansion may result in technically and economically inefficient outcomes. Proper heat pricing and heat purchase agreements are needed to achieve least-cost solutions.

Another primary problem is financing. Through 1998 it was rare for a bank to loan funds for more than two years. The situation immediately after August 1998 was even worse. Credit risks increase because information about the financial condition of a particular borrower is difficult to determine in the absence of established financial disclosure norms. Compounding this problem is a legacy of disinformation from the Soviet era, when deceit was considered ordinary and necessary for enterprise operations (Nove 1986).

The Moskvitch automobile factory in Moscow, which was closed in 1996 but later partially reopened, illustrates some of these problems and opportunities (Martinot 1995). The factory, which in 1993 produced 120,000 cars, was one of the largest automobile plants in Russia. Space heating costs alone, including several buildings above one million cubic meters in volume represented more than one-third of total plant energy costs. Electric motors represented 50 to 60 percent of total electricity consumption, a common figure in Russian industry. According to the plant energy engineer, energy costs represented up to 12 percent of total production costs in 1993, depending upon production volume and time of year. From 1993 to 1995, electricity prices had risen by a factor of two and heat prices had risen by a factor of eight.

Energy-efficiency opportunities identified by engineers at the Moskvitch plant included: variable-speed ventilation systems, automatic control systems for both heat and peak electricity usage, hot-water

temperature regulators, and more efficient natural-gas burners. The chief energy engineer was particularly interested in reducing heat consumption and reducing peak electric power demand (for which a premium was paid). He had a good idea of what technologies to use, had made estimates of potential energy savings, and had gathered technical information from several foreign and domestic firms.

However, the chief energy engineer still did not have an accurate idea of the costs of such improvements nor of the rates of return on investment. He did not have either outside financing or support from senior plant management to finance the improvements out-of-pocket. The plant had difficulty securing loans because production was decreasing and future demand was uncertain, in part due to high prices stemming from inefficient production processes. In fact, the plant had trouble simply meeting its payroll. As it turned out, demand for Moskvitch cars fell so drastically that the plant was forced to close, at least temporarily, despite the fact that the Moskvitch was one of the most commonly purchased cars at the end of the Soviet era.

Russian managers are overwhelmed with problems in marketing products, obtaining production inputs, getting paid by customers, and simply meeting payrolls. In relation to these concerns, attempting to cut energy costs is a low priority. Yet saving energy can offer a positive cash flow immediately or in a very short time, and is vital for improving competitiveness of Russian industry.

Housing

During the Soviet era, housing construction was driven by quantitative plan targets with little or no attention to producing energy efficient buildings. Moreover, despite the frigid climate, very low energy prices meant that costs of construction always overshadowed heating costs. Inadequate building maintenance and poor heating controls seriously aggravated energy losses. Boris Nemtsov, the ill-fated First Deputy Prime Minister who sought in 1997 and 1998 to transfer the burden of housing utility costs from government to private owners, stressed that the legacy of energy inefficiency was jeopardizing the entire reform program.

Energy efficiency opportunities are largest for space heat and hot water because these typically account for two-thirds to three-quarters of residential energy consumption. Demonstration projects and analyses have shown that energy-efficiency improvements and better heating controls can reduce energy costs of apartment buildings by 25 percent or more with economic payback times of five years or less (Nekrasov et al. 1993; Kazakevicius et al. 1996; Martinot 1997; Martinot 1998b).

Higher residential energy costs have caused severe budget pressures on municipal governments, which continue to subsidize housing and utility costs even after apartment privatization (albeit with help from federal allowances). Costs for heat and hot water averaged $30 to $50 per month for a typical apartment in 1995, about 25 to 40 percent of the average monthly wage. Typical subsidies averaged 70 to 80 percent of actual costs at the end of 1996 (Freinkman and Starodubrovskaya 1996). Municipal governments throughout Russia were typically spending 30 to 45 percent of their *total* municipal budgets on these subsidies (World Bank 1996a). In response, municipal governments have been reducing utility services. Social surveys have shown growing dissatisfaction with housing and energy services, including inadequate heating and hot water supply (Guzanova and Diachenko 1996).

A federal government decree mandates gradual phase-out of subsidies by 2003, which will have a severe impact on households. Without subsidies, housing and utility costs could reach 30 to 40 percent of average household income. A burden on municipal governments will also remain because of housing allowances for low-income households, which will dramatically increase as housing costs become a larger share of

household income.

Despite these pressures, privatization and high energy prices have not reduced energy usage in apartment buildings. Energy-efficiency improvements are practically ruled out by current conditions (Martinot 1997). The main challenges include:

(1) Municipal responsibility. For the most part, the institutional and management structures associated with responsibility for buildings have not changed at all after privatization. Generally, this means that municipal governments, through municipal housing maintenance organizations, are still responsible for building operation, maintenance, and capital improvements.

(2) Homeowner associations. Most energy efficiency measures require changes to the common areas and equipment of buildings, not to individual apartments, and thus require a collective decision-making mechanism. But residents of apartment buildings can be collectively responsible for their building only after they organize into a homeowner association. Although the necessary federal legislation was passed in 1993, effective legal frameworks have been slow in emerging and very few homeowner associations have formed. Residents are reluctant to assume responsibility for a building that could require costly repairs. Once an association forms, the financial losses resulting from households that do not pay their utility bills become the responsibility of the association (rather than the municipal government, local utility company, or an enterprise), and thus are shared by all households within the building. Also lacking are guidelines and decision-making models of how homeowner associations should function.

(3) Metering. Heat, hot water, and gas are not metered in apartment buildings. Without meters, households do not pay for consumption according to actual use, but instead pay a fixed monthly amount based on the size of their dwelling, the number of registered inhabitants, and the type of appliances present (i.e., stove, water heater, and bath). Households face zero marginal-cost for their energy consumption and thus have no incentive to conserve or invest. Although building-level metering is a necessary first step, apartment-level metering would create a larger range of conservation incentives. But apartment-level metering poses special difficulties because of the physical piping arrangements in Russian buildings and because of the need for more costly meter reading and billing systems.

(4) Controls. During the Soviet era, radiators were installed without adjustable valves. The standard method of temperature control was to open a window, even in the dead of winter, because radiators lacked adjustable valves. In household surveys, virtually all respondents wanted radiator regulators. In addition, entire buildings can be over- or under-heated because heat-supply levels are determined by the operators of central heat-supply plants, and there are no building-level controls that residents can adjust.

(5) Finance. The lack of financing for households, homeowner associations, and real-estate developers is a serious obstacle. Banks are not willing to lend without adequate collateral and guarantee mechanisms, but homeowner associations have few assets. The institutional problem of how to secure a collective loan with individual property requires that new laws be enacted. In order to obtain financing, households must also have good information about technical opportunities, costs and benefits, and realistic managerial and technical capabilities for specifying, contracting, and supervising building improvements.

(6) Social heterogeneity. There is often a high degree of variation in socioeconomic status and household income among households in the same apartment building. In the Soviet era, building occupancy was generally assigned without regard to the socioeconomic status or income of households. Consequently, buildings now house an essentially random mixture of socioeconomic groups. If the required majority of households in a homeowner association collectively decides to invest in energy efficiency, lower-income households in the same building will be forced to pay their share of renovation costs. If low-income residents

are unable or unwilling to pay, the other households may end up trying to evict these low-income households, producing a difficult social situation.

(7) Regulation. Municipal utility regulations are deficient. For example, the basic institutional question of who purchases, owns, and maintains heat meters in buildings has not been resolved. Administrative and regulatory structures will need to be created to bill households according to actual consumption once meters are installed. District-heating companies will need to be regulated to permit buildings to vary their heat consumption autonomously, which may necessitate technical or operational changes in the district-heating system itself.

Figure 1. Market Intermediation

Securing the support of government officials

Finding and matching potential investment and joint venture partners

Arranging sources of finance and engineering financing schemes

Evaluating and verifying information about partners and projects

Obtaining information about technologies and understanding markets

Identifying potential investment projects

Estimating the costs, benefits, and risks of investment projects

Packaging projects for public or private investors

Securing and structuring credit guarantees and guarantees of project performance

Developing licensing arrangements

Negotiating and writing contracts

Engendering trust among project participants

Obtaining necessary licenses and government approvals

Preparing technical specifications and bidding documents

Bidding and selecting bids for equipment and installation services

Managing, supervising, monitoring, and evaluating projects

Government Leadership

Government has a key role to play in supporting ?market intermediaries? related to energy usage. Such intermediation would introduce the knowledge, services, and financing that are necessary to overcome the barriers to energy efficiency discussed above. The intermediaries would provide economic, political, bureaucratic, and legal functions (see Figure 1) that were mostly unnecessary in the Soviet era but are crucial today (Usiyevich 1993).

In the United States, policies for market intermediation for energy efficiency have taken several specific forms. Examples include tax breaks for energy service companies; special regulatory incentives that give intermediation tasks to existing regulated organizations (such as electric power utilities and demand-side management programs); laws allowing independent power producers which have spawned ?project developer? intermediaries; and appliance and equipment labeling standards. Other policies include direct provision of information to consumers and manufacturers, taxes and subsidies, credit services, enhancement of distribution systems, and direct government participation in equipment manufacture.

These same intermediation policies are relevant for Russia. In particular, energy service companies are one of the most important potential vehicles for market intermediation (Martinot 1998a). Energy service companies provide the project evaluation and implementation services, purchasing, financing, and experience necessary to undertake energy efficiency investments in industry. They often provide a ?shared-savings? arrangement with their client (also called "performance contracting"), which reduces risks and encourages enterprises to undertake energy efficiency investments.

Many existing structures also can act as market intermediaries: departments or agencies of municipal and regional administrations, non-profit organizations, electric power utilities, and enterprise associations. Information and business intermediaries have already grown in importance, including the non-governmental Center for Energy Efficiency in Moscow (Chandler et al. 1996). In the future, Russian banks may also be significant intermediaries offering project evaluation and financing mechanisms. Independent power producers were allowed starting with the 1996 Russian federal law "On Energy Efficiency." Other federal and regional policies have established ?energy-efficiency funds? to finance industrial conversion to energy-efficient products (IEA 1996).

Government programs can also develop human and institutional capabilities. Examples include business plan training, training in energy management, and entrepreneurship for energy service businesses (Evans and Legro 1997). Programs should target engineers, managers, and local government officials. There is also a need to develop the role of regional energy commissions throughout Russia. These commissions can play a role in establishing mechanisms and regulations to encourage and support energy-efficiency activities, including regulating independent power producers. Thus far, these commissions have had little staff or expertise to carry out their responsibilities.

Municipal governments may save on housing subsidies by making investments to improve energy efficiency of apartment buildings before they are privatized. If an investment is made in a building that is expected to become private property before investment costs are fully recovered, then there should be mechanisms for the government to recover investment costs from the future owners. Heat meters are a good place to start investing, and municipal governments in Ukraine have begun to do this.

In one of the first examples of municipal investment in energy efficiency, the World Bank in 1996 signed a 300 million dollar loan with six municipal governments in Russia to improve the energy efficiency of apartment buildings (World Bank 1996a). The objective was to reduce the municipalities? financial burden

from housing that was being transferred from enterprise to municipal ownership. The energy-efficiency investments have aggregate payback times of less than five years. With a 15-year loan term, the cities expect positive financial returns from the loan immediately after installation of the measures.

Municipal governments need to develop administrative systems for consumption-based metering and billing in the residential sector, along with regulations to specify a new system of consumption-based energy tariffs. With building-level or apartment-level metering, a database of building characteristics must be created in order to allocate building-level heat meter readings among all households within a building. An agency must be created, equipped, and trained to read heat meters and calculate heat payments on a monthly or annual basis. New administrative mechanisms must incorporate calculated payments into household energy bills. New municipal regulations must give appropriate authority and budgets to the new agencies. Without new regulations, district-heating companies are not likely to allow changes in consumption that will require changes to their systems. Regional energy commissions may also need to approve the transformation of residential heating tariffs from a per-square-meter to a per-gigacalorie basis.

Government policies should promote homeowner associations as vehicles for improving energy efficiency. Studies have shown that homeowner associations in the former Soviet Union need access to organizational, legal, financial, and technical advice. Public advisory centers are one way to provide this support. In a test activity, the Lithuanian Ministry of Construction and Urban Development helped four homeowner associations go through a process of borrowing from commercial banks and implementing energy-efficiency improvements. Direct assistance was provided to the associations at each step in the process, including: (1) inviting associations to take the loan, (2) obtaining a mandate from association members, (3) gathering technical and procedural information, (4) preparing a proposal that identified options and their respective costs and benefits, (5) choosing a course of action and inviting bids from contractors, (6) selecting a bid, (7) negotiating with contractors, (8) negotiating with banks, and (9) overseeing construction and installation. The activities in this project illustrate the kinds of support homeowner associations require (World Bank 1996b).

Public education campaigns are important for educating households about energy efficiency. Experiences of homeowner associations could be publicized through radio or television interviews of association members. New homeowner associations need to become aware of technological opportunities and the possibilities for credit. Understanding of management issues is crucial since energy-efficiency projects require so many kinds of expertise.

Policies to strengthen legal and market institutions will assist energy efficiency investments along with all forms of investment. Standards are needed for contracting, accounting, and performing credit ratings. Regulations should provide strict procedures for financial audits of enterprises so that the financing risks for bank loans are reduced. In particular, stronger contract law would reduce the risks faced by energy-service companies and facilitate “performance contracting.”

It is the responsibility of government to provide the balanced macroeconomic policies necessary to make available long-term credit. Government could also institute a variety of ?carrots and sticks,? including tax incentives for investments in energy conservation and penalties for wasteful energy use.

Market-determined energy prices, elimination of subsidies, and privatization of enterprises and apartments are all important so that market forces can promote efficiency. However, the market operating by itself will bring about only sluggish improvement. Government leadership could accelerate gains in energy efficiency in factories and homes.

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