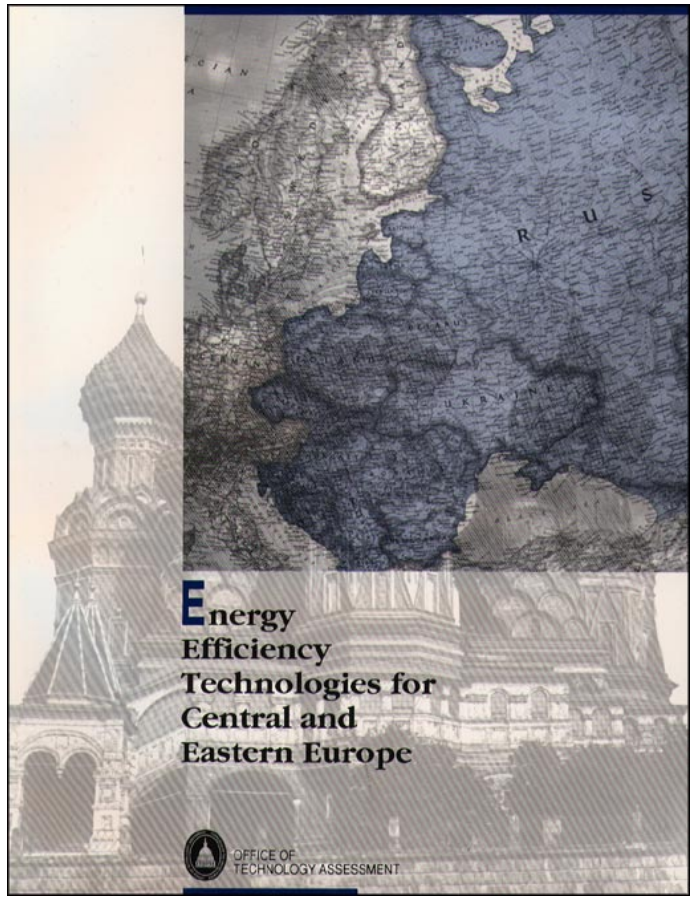
Energy Efficiency Technologies for Central and Eastern Europe

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Foreword

The Senate Committee on Environment and Public Works, the House Committee on Foreign Affairs, the House Committee on Energy and Commerce, the Senate Committee on Foreign Relations, and the House Subcommittee on International Development, Finance, Trade, and Monetary Policy requested an assessment of energy and environmental technology transfer to Central and Eastern Europe. The intent is to determine how U.S. energy technology can help in resolving the economic and environmental problems of the region, and the impact of measures to expedite the process.

This report, the first of two from that assessment, focuses on the improvement of energy efficiency. It reviews how energy is used in the former centrally planned economies. Then it analyzes the potential effectiveness of modern technology in reducing energy waste and the factors that constrain improvements. The report also examinesgovernment programs assisting energy efficiency technology transfer and opportunities for U.S. businesses. Finally, it discusses congressional policy options to support technology transfer.

Technology transfer to improve the efficiency of energy use is a highly cost-effective way to support economic reform, democratization, and stability in the former Communist countries. Energy is used very wastefully in Russia, Ukraine, Poland, Hungary and other formerly centrally planned economies. This waste limits economic development and contributes to local and global environmental degradation. Thus this report is timely for congressional deliberations on assistance to the region, on how to increase U.S. exports, and on how to reduce environmental problems.

The second report, to be released in 1994, will address issues of energy supply as well as continuing the analysis of energy efficiency.

OTA appreciates the invaluable advice and assistance of the many people who contributed to this project, including the advisory panel, participants at the two workshops, reviewers, and contractors.

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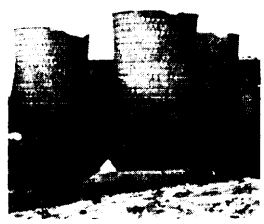
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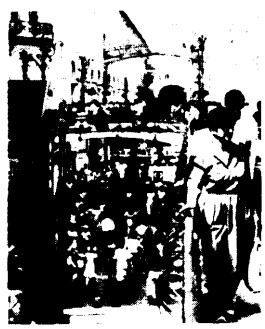
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Overview

Energy Efficiency Technologies for Central and Eastern Europe

Much of the energy consumed in the former Communist countries is wasted. Efficiency improvements requiring only modest investments will permit these economies to operate with dramatically less energy. However, constraints such as inadequate capital and expertise are limiting the implementation of these measures.

Improving the efficiency of energy use would assist in the transition to a market economy. Russia is a major producer of oil and gas, and it could finance much of the rebuilding of its economy by exporting fuels freed up by reducing waste. The Baltic nations, Ukraine, Poland, Hungary, and the former Czechoslovakia lack hard currency for economic revitalization, due in part to the high costs of imported energy.

It is in the U.S. national interest to see these countries succeed in the transition to prosperous, democratic societies because:

- international political stability will increase,
- U.S. defense budgets can drop, and
- commercial markets for U.S. goods and services will grow.

In addition, increased energy efficiency will reduce the pressure on world oil markets and address environmental concerns, notably global climate change.

Efficiency can be improved through a wide variety of measures in all energy consuming sectors. The industrial sector is especially well suited for rapid gains in efficiency. Implementing energy-efficient technologies will require incentives to make changes, awareness of the opportunities, and capital for investments. Simple changes, such as fixing steam leaks, can be done immediately with little capital; improved boilers, process control systems, and electric motors will take greater investment. As outdated factories are replaced with modem ones, major improvements will be realized because energy efficiency can be integrated throughout the plants.

In the residential sector, radiator valves can reduce space heating needs; improved lighting and appliances can conserve electricity; and improved controls and insulation can reduce coal use at district heating plants. However, even well-retrofitted existing buildings are much less efficient than properly designed new buildings, and construction of new buildings is likely to be slow. Transportation sector efficiency improvements will be even more dependent on the replacement of existing equipment and on major system upgrades, which will take many years.

In the long term, economic reform and revitalization will be key to improving energy efficiency. Modem technology in all sectors offers major economic and environmental gains, as well as

energy efficiency. Decision-makers must be given proper incentives to minimize costs, including energy, and they must have information on their opportunities. Current energy efficiency assistance is a vital element in creating the expertise and funds that will be needed to develop a modem economy.

Technology transfer contributes directly to development because it builds a foundation for a country's capabilities. Industry supplies most technology transfer through information accompanying the sale of products and services, investments in production facilities, or through the direct sale of expertise. The government can expedite industry's transfers and also supply information and capital directly through finding specific assistance projects.

Most energy assistance has focused on supply--side projects, i.e., the development and rehabilitation of supply infrastructure (primarily the natural gas and power industries), but interest in energy efficiency projects is growing. The United States is the largest aid source for energy efficiency and conservation projects, followed by the European Community. The World Bank and the European Bank for Reconstruction and Development (to which the United States is the largest contributor) have provided the bulk of energy financing, but very little (as low as 1 percent of energy lending) has gone to efficiency projects.

The potential market for energy-efficient products is very large if these countries can develop sufficiently to afford them. One estimate is $20 billion for energy-efficient industrial products. However, the United States is not well positioned relative to its competitors to tap this market because:

1. overall assistance to Central and Eastern Europe is not large enough to support more than a small fraction of the potential market;
2. there are few U.S. Government export assistance programs that support smaller firms which account for much of the energy efficiency industry; and
3. energy efficiency companies are not well organized to export, and relatively few appear to have the experience or long-term perspective needed to deal with the uncertainties inherent in Central and Eastern Europe at this time.

Potential Energy Savings

The energy savings potential in Central and Eastern Europe, although poorly documented, is considerable by all accounts. The iron and steel industry in the former Soviet Union, for example, uses about 50 percent more energy per unit of output than does the United States. Similarly, buildings in the FSU require about 50 percent more energy per square foot to heat.[1] Overall, the FSU used 57 quadrillion BTUs (quads) of energy in 1991, two-thirds of what the United States required (82 quads) for an economy several times larger. If *all* energy use in the FSU were cut one-third (and this is a modest goal considering that other countries are more efficient than the United States), the savings would be about 19 quads, equivalent to about $40 billion dollars per year.[2]

Although considerable investment would be needed to realize this $40 billion savings potential, most investments would be paid back rapidly—in some cases in less than one year, equivalent to a financial return of over 100 percent. Although these estimates are uncertain, they do suggest that the technical and financial savings potential is huge.

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[1] This estimate controls for climate differences as discussed in chapter 4.

[2] FSU consumption by fuel from Energy Information Administration, International Energy Annual, p. xiii. Energy prices from Energy Information Administration, Annual Energy Review 1991, pp. 69, 229.

SOURCE: Office of Technology Assessment, 1993.

The U.S. Government is supporting a variety of efforts to supply the information and financial support needed to improve efficiency. Energy efficiency centers have been established in Poland, Russia and the Czech Republic to provide advice and assistance. An energy audit program for industrial facilities is providing recommendations for improvements and limited support for implementation. Training and demonstrations also appear to have been effective.

A strong assistance program can be a major element in helping Central and Eastern Europe through their present difficulties. Energy efficiency assistance will be beneficial for both the United States and the recipients regardless of political developments. If Congress is willing to increase assistance, substantial increases in several elements of the current program would be effective. In particular, information programs such as the energy efficiency centers, technical demonstrations, and training could be expanded. In addition, assisting enterprises in purchasing new energy efficient equipment and upgrade production and buildings, etc. would address the problem of lack of investment funds. Increasing assistance would benefit American companies and help position them for the future, but it would be expensive for the U.S. Government. Modifications to the assistance program, particulary eliminating restrictions (e.g., on procurement), can make it work more effectively.

Increased export promotion, such as helping American companies find market opportunities, would also provide benefits to the American economy. However, these programs will require increased Federal funding, even if they provide net benefits, and must compete with other national needs.

Introduction 1

Euphoria over the dramatic events of the past 3 years in the former Communist countries of Europe has yielded to a realization that converting to a free-market economy will be very difficult. The old economic system focused almost exclusively on the quantity of production rather than quality or cost, which resulted in an astonishing waste of inputs such as labor, materials, and energy, as well as a near total disregard for the environment.

Introduction of economic reform has had varying degrees of success. In Hungary, Poland, and the Czech Republic, signs of progress are clearly apparent, although their economies have not yet rebounded. Reforms in the newly independent states of the former Soviet Union and other Eastern European countries are hampered by problems such as internal political struggles, ethnic strife, an outdated industrial infrastructure, and a mindset that finds market incentives an alien concept. Termination of old economic systems without replacement by new, functional systems has resulted in economic chaos, which itself has made further reforms more difficult.

The United States has a clear national interest in seeing these nations succeed in their transition to prosperous, democratic societies. The trillions of dollars spent over the past several decades in defense against these same countries underscore the value of their present friendship. If the reforms fail, particularly in Russia, authoritarian factions could seize power and start a new cycle of hostility. Even the smaller countries have enormous potential for causing harm, especially considering all the nuclear weapons and expertise that could be unleashed on the world market. On a more positive note, these countries could become major markets for U.S. goods and services.



Daniel Talmo

Parliament Building, Budapest.

Energy is a key factor in economic reforms. The Soviet Union was the world's largest producer of petroleum and a major exporter on world oil markets. In fact, oil exports were by far the largest source of foreign exchange and apparently propped up an otherwise bankrupt system for far longer than would have been otherwise possible. Exports have declined along with production over the last several years, but a turnaround is possible, especially with western technology. Additional hard currency revenues from increased exports of oil are likely to be essential in funding the rebuilding of the industrial sector. The region, especially Russia, is also extraordinarily rich in natural gas, coal, and uranium.

As important as increasing production will be, the greatest gains, especially over the next 5 to 10 years, are likely to be from efforts to upgrade the use of energy. The great natural resource wealth of the region led to the sense that energy was inexhaustible. Central planners kept energy prices low in order to facilitate industrial production and social welfare. The result was what appears by western standards to be extraordinary profligacy in the use of energy. For example, radiators in many buildings cannot be adjusted, so people open windows to regulate the temperature, even in bitterly cold weather. At some industrial facilities, over half the process steam is lost through leaks; the U.S. norm is less than 5 percent. Reducing this waste means that the services required can be performed with less energy, i.e., with higher efficiency.

In the United States, the efficiency of energy use has improved dramatically since the rapid price increases of 1973-74. Energy consumption per dollar of Gross Domestic Product declined by 27 percent from 1973 to 1991.[1] This improvement has been the result of many small changes in each sector. For example, industrial facilities have installed equipment to capture heat that formerly would have been exhausted to the atmosphere; houses have been insulated; and automobiles are lighter and have greatly improved engines. typically, some additional investment is required to improve efficiency of equipment and facilities, but the energy savings return the investment several times over.

Such improvements **did not occur in the** centrally planned economies. Implementing them now can eliminate the need for large quantities of energy. Excess fuel then could be exported from the region. The increase could be in the range of millions of barrels per day of oil equivalent, providing a major increase in revenues to oil exporting nations, especially Russia. Improved efficiency would also benefit the oil importing countries of Central and Eastern Europe, which now are suffering serious shortages because of an inability to pay for all their needs. Reducing energy consumption in all these countries also will reduce pollution in one of the most polluted regions of the world. In addition, carbon dioxide emissions would drop with the reduction of fossil fuel combustion, significantly slowing global climate change.

The United States will benefit as well from these improvements. World energy prices should decrease with the increase in exports. As the world's largest petroleum importer, the United States will benefit from increased supplies on the world market.

The market incentives now being introduced as part of economic reform will help reduce waste. Energy that could be exported, or must be imported, costs the nation the full world price. Subsidizing the price to consumers may be a necessary short-term social policy during the transition, but it can be an extremely expensive policy. As prices rise to the level of real costs,

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[1] U.S. Department of Energy, Energy Information Administration Annual Energy Review 1991, DOE/EIA-0384(91) (Washington, DC: U.S. Government Printing Office, June 1992), p. 27. About two thirds of this improvement was from improved efficiency and the rest from structural shifts within the economy, as discussed in Energy Use *and the U.S. Economy*, OTA-BP-E-57 (Washington, DC: U.S. Government Printing Office, June 1990).

energy users can find ways to provide energy services with less energy. As economies revive, modern industrial facilities, designed from the ground up to minimize costs, will replace outmoded ones. Such facilities can capture all the advantages of the retrofits applied to old facilities, plus many more that are fundamental to the basic processes involved.

However, both energy reform and economic reform are proving difficult and slow to implement. Energy prices in some countries are still controlled well below world levels, reducing the incentive to control waste. Even at subsidized prices, many attractive efficiency investments are available, but industrial managers still ignore them for various reasons, including unfamiliarity with the entire concept of cost control, lack of funds to make any changes, or institutional barriers such as concern that they would not be able to keep the savings,

Furthermore, it has become clear in the United States that market incentives by themselves do not lead to an optimal use of energy, especially considering externalities such as environmental damage and security that affect the national interest. Even in an open market economy, many barriers to the implementation of economical efficiency improvements exist. These barriers include such factors as the higher initial cost of energy-efficient equipment, poor information about the availability of such equipment, and the lack of accounting for external costs such as pollution.

U.S. assistance in promoting energy efficiency directly can be an effective supplement to economic reform. It can provide financial breathing room to the new market economies by reducing costs and increasing exports. It can ease the pain of economic reform among energy users, thereby allowing reform to proceed more rapidly. In addition, these measures may provide tangible examples of how to implement modem technology and respond to market incentives, which could create the initiative to pursue other improvements. Furthermore, the increased expertise should be important in ensuring that energy



Larry Markel

Uncontrolled emissions from a combined heat and power plant in Poland.

efficiency is given due consideration in the design of new facilities. However, it is possible to overemphasize energy efficiency. Programs must be designed in the context of the overall effort to help the nations of Central and Eastern Europe in order to achieve optimal, balanced results. Furthermore, there is no guarantee that all these nations will make a successful transition to free markets and democracy even with generous assistance. Some funds may be wasted.

This report presents the interim results of an analysis of the technologies the United States could supply to help reduce energy waste, and what the consequences are likely to be for all parties concerned. It addresses questions of improving the efficiency of energy consumption, i.e., using less energy to perform a given service.

The final report, to be published in 1994, will complete the analysis of energy efficiency and also address issues of increasing the production of energy, in particular petroleum and natural gas. In addition, the energy industry itself wastes large amounts of energy during production, processing, and delivery. The final report will analyze technology transfer to reduce this waste. It will also include nuclear safety and control of pollution in the energy industry.

Technology transfer, a process of conveying information necessary to improve some capability to design or produce goods and services, is likely to be the best help the United States can offer to promote development in Central and Eastern Europe. The key is information. Sending radiator valves and thermostats would help save energy, but would not add new capability. Examples of technology transfer include design concepts for efficient buildings; manufacturing capabilities for new building materials; training for energy auditors; even the expertise to design appropriate building codes. Ultimately, these countries will have to rebuild their own economies. The West cannot do it for them, but supplying new capabilities will accelerate the process.

Technology transfer can be accomplished by government, industry, or private institutions. Industry is likely to be the most important actor, through direct investment, joint ventures, and training to accompany sales. Education also is very important. A great many foreign students in U.S. science and engineering programs return home with a sophisticated technological background as well as potentially important links with the United States.

The U.S. Government can supply technology directly through assistance programs, agency contacts, and access to databases. However, the need is likely to greatly exceed available government resources. This report considers how to get the most out of the funds that will be available. In addition, U.S. policies can be an important determinant for industry and other groups through trade promotion, foreign assistance, export controls, bilateral agreements, tax policies, and other means.

This study focuses on the Central European countries Poland, Hungary, the Czech and Slovak Republics, and Eastern Europe, including Russia, Ukraine, and the Baltics. All the countries of the region share some common attributes, including the problems of making the transition from command to market economy. However, they also show great differences. Even the former Soviet Union is now 15 sovereign nations which will follow different paths, whether or not the Commonwealth of Independent States, a loose alliance of most of them, succeeds. These differences must be considered when designing assistance programs. Thus analyzing the situation is extremely complex, made more so by difficulties in getting reliable, up-to-date data. This study is not an exhaustive survey of all the energy problems in that region, nor of all the opportunities for U.S. technology transfer. Rather, it seeks abroad understanding of the problems, the potential role for U.S. technology in addressing them, and the U.S. interests and options in doing so.

Economic and Political Context 2

The 26 former Communist nations are extraordinarily diverse.[1] Progress toward democratization and a market economy is very difficult and depends on a variety of political, economic, and social factors. These countries are following similar paths, but they differ in the emphasis given the elements of economic and political reform, and in the success achieved. Efforts to assist them must be based on a realistic understanding of their individual problems and assets. This chapter provides background for the nonspecialist reader. It begins with a brief overview of the economic and political trends in the eight Central and Eastern European countries that are the main focus of this study. The chapter next summarizes some basic demographic characteristics of all 26 nations that formed the former Soviet Union and its satellites.

The remainder of the chapter describes the eight countries in more detail. Brief statistics characterizing gross national or domestic product per capita, major industrial activities, and natural resources are provided. History, energy, and environmental status are briefly sketched. Further detail is provided on the economic and political reforms summarized at the beginning of the chapter. Each country description ends with probable near and longer term outlooks for further reforms.



William Westermeyer

Interior of the GUM department store in Moscow.

[1] This chapter was written in December 1992 and is a snapshot of a region undergoing great change where even the number of countries that may emerge is uncertain. For example, the 26 nations mentioned in the body of the text became 27 as of Jan. 1, 1993 with the division of Czechoslovakia into the Czech Republic and Slovakia.

OVERVIEW OF REFORMS TO DATE[2]

I Economic Reforms

Prior to the collapse of Communist party (CP) rule in 1989, Poland and Hungary, in rather different ways, had adopted reforms that reduced the authority of central planning, provided some pricing flexibility, and modified policies regarding the role of monopolies in domestic and foreign trade, and the practice of full or nearly full employment (but with large underemployment). Czechoslovak reform efforts were very modest. The Baltics[3] introduced some measures of economic reform several years before they achieved independence in 1991. Russia passed legislation decentralizing the economy (within the confines of the U. S. S. R.) and reducing state subsidies during 1990 and 1991 before the Soviet collapse. Ukraine was slow to initiate reforms, concentrating instead on issues of autonomy and independence.

Broad economic reform began in earnest in January 1990 in the Central European countries; late 1991 in the Baltics; January 1992 in Russia; and is just beginning in Ukraine. Thus far, the elements of reform in each country are similar. They include: demonopolization, decentralization, price liberalization, elimination of subsidies, privatization of industry and agriculture, currency stabilization and convertibility, search for foreign investment, and modifications to the banking, insurance, and legal systems to support these changes.

The process of transformation is not complete and will not proceed smoothly. Some policies can be adopted quickly; others may be adopted only after long negotiation; still others may not be adopted at all. The breadth and depth of the reforms planned in each country differ, as does the commitment and stability of the political leadership and the resilience of the population. The pace of reform within each country will continue to be influenced by a variety of internal and external factors.

Each country began the transition from a command to a market economy after a period of grave economic difficulty. Production levels have declined in recent years, and most countries had substantial foreign debt requiring payments that could not be made, as well as an adverse balance of trade. Numerous industrial strikes indicated popular discontent. None of the countries had a convertible currency, and all were hard-currency poor.

Instituting market incentives was widely recognized to be the key to economic wellbeing, but the transition threatened years of hardship and declining standards of living until the new system could produce results. Policymakers in some countries chose to move forward rapidly with reforms despite the threat, believing that a slower path would bog down and ultimately doom the process. But rapid transformation is likely to engender backlash, demands to slow the pace, and opposition to additional reform. Some countries have adopted a slower pace on the assumption that it will cause less hardship and reduce concerted opposition.

The breadth of change needed to accomplish economic transformation guaranteed that the reformers would confront vested interests from the old system at every turn. Not only are the reformers faced with opposition from those who stand to lose; they are also faced with resistance to new ways of operating from both individuals with clout and from groups within the population at large.

Table 2-1 lists the elements in the transition to a market economy and summarizes the progress in each country. The ratings in the table are breed on when each reform was announced, when

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2 The discussions of economic and political refroms in this secction and in the country profiles at the end of the chapter &W heavily on J. S. Zacek, *The Economic and Political Context*, contract report prepared for the Office of Technology Assessment, Dec. 1992.

3 Because of the similarities in their efforts at reform, Estonia, Latvia, and Lithuania are grouped together as ‘‘the Baltics" in this section.

Table 2-l—Movement Toward a Market Economy

Reform	Country					
	Poland	Hungay	CzS1. *	Russia	Baltics	Ukraine
Freeing wholesale prices	H	H	H	M	H	M
Freeing retail prices	H	**H**	H	H	H	M
Encourage domestic investment (including voucher system)	M	M	H	M	M	L
Auctions to sell state property	NA	M	H	L	L	L
Privatization of small businesses	H	H	H	M-L	H	L
Privatization of large enterprises	L	L	M	L	L	L
End state subsidies	H	H	M	M	H	L
Encourage foreign investment (favorable legal climate)	M	H	H	L	M	L
Restitution of property	M	M	M		M	
Ceiling on wages	H	M	M	M	M	M
"Safety net" for unemployed	H-M	H-M	H-M	M-L	M	NA
Reform tax system	M	M	M	L	M	L
Old (CP) management takeovers of enterprises	[H	NA	L	H	L	M
Encourage employee takeovers of enterprises	M	L	L	L	L	NA
Reform bainking system	M	H	H	L	M	L
Loans to pivate sector from banks	L	L	L	L	M	L
Reorient trade from CMEA (or among former Soviet republics)	M	H	H	L	M	L
Favorable trade balance	M	H	M	L	M	L
Foreign debt management	3	3	1	3	1	3
Bankruptcy laws in effect	L	M	M	L	L	L
Demonopolization laws in effect	M	M	H	L	M	L
Interenterprise (state-owned) debt	3	3	2	3	3	3
IMF membership and assistance	H	H	H	H	H	L
Currency convertibility	H	H	H	L	H	L

KEY: H - rapid movement; M - moderate movement; L - slow movement, if at all. NA - no information; 1- not a problem; 2- moderate problem; 3- big problem.

• The Czech and Slovak republics are moving towards reformat different speeds, and the ratings area composite. Generally, Slovakia is privatizing more slowly with a greater state role in economic affairs than the Czech Republic.

NOTE: The ratings reflect whether and how fast reforms were announced, relevant legislation adopted, and judgments on the degree of implementation.

SOURCE: J. S. Zacek, "The Economic and Political Context," contract report prepared for the Office of Technology Assessment, December 1992.

relevant legislation was adopted, and judgment on the amount of implementation so far achieved. It should be noted that thus far, parliamentary support for passage of transition-related legislation has been far easier than its implementation. It is difficult to determine how widespread implementation has been and how much opposition has been encountered.

Two financial problems—the existence and size of foreign debt, and the size of the debt that state-owned enterprises owe one another-are also listed in the table. While not aspects of reform per se, they are critical to the reform process.

Several elements tended to be adopted frost. One was freeing prices in both the wholesale and retail sectors so that they reflect costs of production as well as supply and demand. Freeing prices from artificially low levels was directly related to removing state subsidies on goods, which had kept prices low. In some instances, especially in the consumer sector, policymakers have been reluctant to eliminate state subsidies quickly because of the personal financial dislocations that would result.

Price increases triggered inflation, severe and prolonged in some instances, more carefully controlled through limiting the money supply in others. Initially, price increases were coupled with a ceiling on wages. The wage ceiling limited inflation, but increased hardship.

Freeing wholesale prices affected industrial production markedly. Enterprise directors, used to buying materials at established prices, found that the real costs of doing business were far greater than under the old controlled price system. Unless they could raise the price of their goods, they would operate in deficit, necessitating borrowing to pay suppliers and distributors. If the deficits continued, the loans could not be repaid. One solution is restructuring the enterprise for increased efficiency, but thus far there has been substantial resistance to restructuring.

In general, the table shows that there have been marked similarities in the reform elements each country legislated during its initial phase of transition to marketization.


Joanne Sedor

Apartment house in Moscow.

Political Reforms

Each of the countries moved quickly to hold competitive elections for the legislature. Political parties have been formed and consolidated, and many have begun to establish roots within the electorate and are building long-term support and stability.

The rule of law has been reestablished (or established) and state constitutions are being rewritten. In most cases, judicial systems are being strengthened and the legal structure revamped. Civil rights guarantees have been estab-

lished in principle although they remain to be tested in practice. Protection of private property is being established in law and in practice, although there is still a mind set that favors limits on private ownership (as well as limits on private sector profit-making). Citizen participation in building a democratic order is also developing, more rapidly in some countries than others. Most of these reforms are in process and need time to take root. They are essentail to strengthening the economic transformation and ensuring its chances of success.

1 Likely Outcomes

The political leadership in each country has adopted many of the same strategies to move from centrally planned toward market-based economies. In some cases, prior reforms had loosened the hold of central planners on economic decisionmaking, production, distribution, and supply networks. The post-Communist leaders knew that undertaking economic transformation at a time when their economies were in decline would likely cause further decline and more unemployment, inflation, and other hardships. They were willing to risk these outcomes because there was considerable agreement within the polity and among leadership elites that the old economic system could not be made to work. There was also general belief that restructuring to a market economy was incompatible with central planning, requiring simultaneous movement to more democratic government, pluralism, and competition.

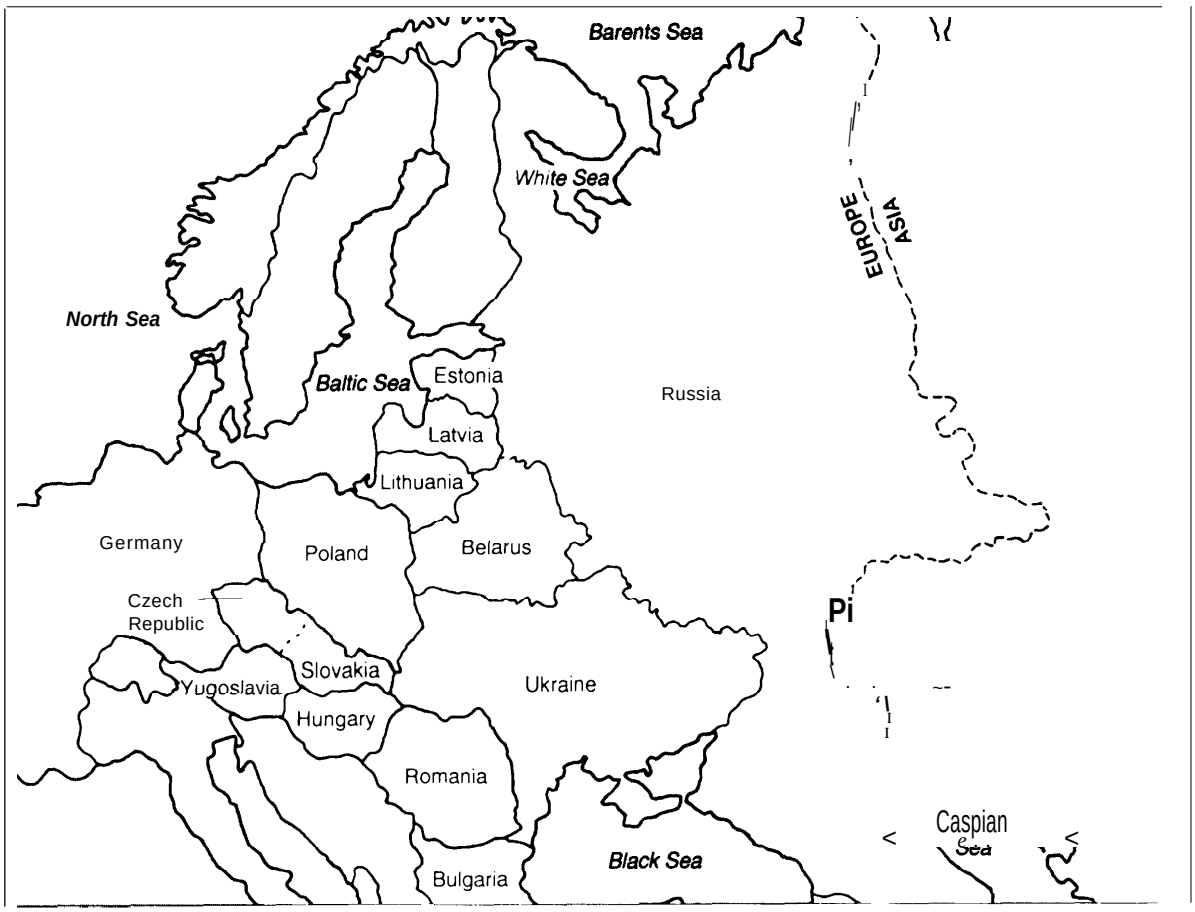
While opposition to reform has come from a variety of sources, including (but not limited to) the old communist bureaucracies still entrenched in the ministries and other organizations and in control of most state-owned enterprises, not all of the old directors and managers want to return to past ways of doing business. Many of them have become the new entrepreneurs, drawing on some of the skills they had developed under the old system in order to get things done and meet output requirements. However, under the old system, they did not need to attend to efficiency and conservation of resources as capitalist managers oriented to profit must. They relied on props (bank credits, interenterprise debt) in order to cover financial losses, and they generally were not pressured to restructure and operate more effectively. Nor was there much incentive to modernize and adapt to new technologies (many of which were not available). These elements are now essential under the new economic conditions, including the need to become competitive internationally.

To summarize probable outcomes on a country basis, Poland, the Czech Republic, and Hungary, as well as the Baltics, are likely to create and sustain market economies within the next 5 to 10 years. On the way, they all face difficulties in implementing reforms, will experience slow periods, and will sometimes be guided by electoral returns. They are also likely to sustain and strengthen democratic institutions, broadly defined. Slovakia is likely to move more slowly.

Russia and Ukraine are problematic. Both are likely to retain a strong state presence in the economy and at best develop a mixed public/private system. Russia faces internal opposition from several ethnic minorities as well as proposals for economic and political autonomy from Siberia. While it is unlikely that Russia will disintegrate, it is certainly possible that an authoritarian political system will be established to ensure that the country remains intact. Ukraine also faces difficulty in maintaining and preserving a national state and possible military, economic, and territorial disputes with Russia. It is likely to retain a significant government role in the economy to ensure a basic level of economic performance. To meet these needs, the government may seek greater stability through establishment of authoritarian rule.

With respect to energy use, governments in these countries must take the lead in prodding both public and private businesses to adopt energy efficiency measures if these are to occur. Elimination of subsidies and imposition of taxes

Figure 2-l-Central and Eastern Europe



SOURCE: Office of Technology Assessment, 1993

would encourage efficient usage and conservation. Because of the initial costs involved, financial credits will be needed. Foreign assistance, including technical assistance (linked to progress in privatization) is probably indispensable in the initial stages of improving energy efficiency.

DEMOGRAPHIC CHARACTERISTICS

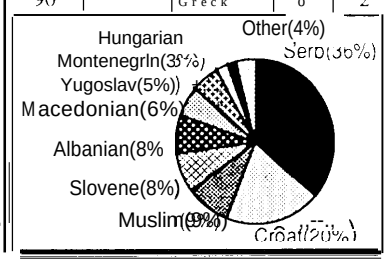
The 26 countries that were once part of the former Soviet Union (FSU) and its satellite nations are listed in table 2-2. A map of the region is shown in figure 2-1.

Differences among these countries arise from their history, and the great size of the region. Until boundaries stabilized with the formation of the Union of Soviet Socialist Republics in 1922, Russia had been annexing territory at the rate of 18,250 square miles per year for four centuries.[4] The result was a union stretching across 11 time zones with more than 100 different nationalities

[4] G. J. Demko, J. Agel, and E. Bee, *Why In the World: Adventures in Geography (New York, NY:* Doubleday, 1992), pp. 101-102.

Table 2-2—Major Demographic and Ethnic Characteristics in the Republics of the Former Soviet Union and Eastern Europe

Region or Country	Population * x2	<15&>65	Total	% Lbr in Agr	% Urbar	Nationality (%) Titular	Russian	Other n jor		Other
FSU										
Russian Republic	301	23/10	149.3	13	74	82	same	Tatar	4	14
Baltics										
Estonia	365	NA	1.6	6	71	62	30	Ukrainian	3	5
Latvia	630	21/12	2.7	NA	71	52	34	Belarus	5	9
Lithuania	158	23/11	3.7	9	69	80	9	Polish	7	4
Western Europe										
Belarus	217	23/10	10.3	10	67	78	13	Polish	4	5
Ukraine	1,15:	22/12	52.1	8	68	73	22	Jewish	1	4
Moldova	88	28/8	4.4	16	48	64	13	Ukrainian	14	9
(Trans)Caucasus										
Georgia	80	25/9	5.5	NA	56	70	6	Armenian	8	16
Armenia	40	30/5	3.5	10	68	93	2	Azeri	3	1
Azerbaijan	36	33/5	7.1	13	53	83	6	Armenian	6	5
Central Asia										
Turkmenistan	26	41/4	3.9	18	45	72	9	Uzbek	9	10
Uzbekistan	25	41/4	21.3	15	40	71	8	Tajik	5	16
Tajikistan	22	43/4	5.5	16	31	62	8	Uzbek	24	6
Kyrgyzstan	31	37/5	4.5	13	38	52	21	Uzbek	13	14
Kazakhstan	50	32/6	16.9	7	58	40	38	German	6	10
EASTERN EUROPE										
East *Central Europe*										
Poland	*187*	25/10	*38.4*	29	61	98		German	1	1
Czechoslovakia	*347*	23/12	*15.7*	12	*76*	63		Slovak	32	5
Hungary	*NA*	20/14	*10.3*	19	*63*	97		German	?	2
Southeastern Europe										
Romania	*578*	23/11	*23.2*	28	*54*	89		Hungarin	8	3
Bulgaria	*NA*	20/13	*8.9*	20	*68*	85		Trurkish	9	6
AIbania	*36*	33/5	*3.3*	60	*36*	90		Greck	8	2
Formcr Yugoslavia										
Bosnia-Hercegovia]	*90*	28/6	*4.2*	NA	*36*					
Croatia	1,386	21/12	*4,6*	NA	*51*					
Macedonia	70	29/7	*1.9*	NA	*54*					
Slovenia	267	23/11	1.9	NA	*49*					
Yugoslav Repub.	131	24/9	10	NA	*47*					
UNITED STATES	89	22/1 3	255.6	3	75					



UNITED STATES: 1% Amer. Indian/Native Alaskan, 3% Asian, 12% Black

• "x2" - the number of years for the population to double; "<15&>65° - the O/. of the population that is less than 15 years old & is greater than 65 years; "Total" = total population, mid 1992 estimate, in millions.

SOURCES: Population and % Urban data from Population Reference Bureau, 1992 World Population Data Sheet (Washington, DC: Population Reference Bureau, 1992); FSUNationality data from Directorate of Intelligence, Central intelligence Agency, "The States of the Former Soviet Union: An Updated Overview," Report OSE 92-10017, September 1992. FSU % Labor in Agriculture (1990) data calculated from table 1.1. in The World Bank, "Statistical Handbook; States of the Former USSR," (Washington, DC: The World Bank, 1992). Eastern Europe Nationality and % Labor in Agriculture data from Central Intelligence Agency, "Atlas of Eastern Europe," Report 90-10002, August 1990. U. S.% Labor in Agriculture and racial data from U.S. Bureau of the Census, "Statistical Abstract of the United States: 1992, Washington, DC, 1992.

speaking different languages and rooted in vastly different cultures. The addition of the Baltic states in 1940 and later, the Central European satellites, increased diversity still further.

Of the 26, Russia is by far the largest, more than 6 times larger than the next largest republic, Kazakhstan, and about twice the size of the United States. Russia also has the most people, with almost 150 million. The total population of all 26 nations is more than 400 million, considerably more than the U.S. population of 256 million.

Table 2-2 shows basic demographic and ethnic characteristics of the FSU and its former satellites. Major differences are apparent, especially among regions. Four of the Central Asian countries, along with nearby Armenia and Azerbaijan, double their populations in 20 to 40 years, rates typical of developing countries in Africa, the Middle East, and Asia (see column 2, labeled "x2" meaning years to double, in table 2-2). Ukraine and Croatia, on the other hand, have highly stable populations, with more than 1,000 years projected as the time needed for their populations to double.

The proportion of the population that is young (less than 15 years) or old (more than 65 years) and hence not counted as part of the labor force typically reflects population growth characteristics, and these countries are no exception. As expected from their high growth rates, the Central Asian countries have populations heavily skewed towards youth. About 40 percent of their populations are less than 15 years old, and the proportion of older people is small, about 5 percent, compared to the developed world where around 20 percent are less than 15 and 12 percent are older than 65. Central Asian population characteristics spell both promise for labor and productivity, and trouble if jobs are not available and expectations not met, especially without the leavening influence of more older people in the population.


Helene Kirwan-Taylor

Suzdal, a village in Russia.

The percentage of the labor force employed in the agricultural sector (see column 5 in table 2-2) ranges from 2 to 20 times that seen in the United States. These numbers are partly a consequence of the inefficiencies of the Soviet system of collectivized farming. As farming is modernized, large numbers of people will swell the ranks of the unemployed if provisions are not made to ensure that they have useful work.

The FSU overemphasized industry, especially heavy industry, at the expense of the service sectors In Russia, industry accounted for 53 percent of Soviet output compared to 23 percent in the United States. Conversely, services account for about 50 percent of U.S. output but only 15 to 20 percent of Russian output.

Most of the 26 countries are less urbanized than the United States, some substantially so. The Russian Republic and Czechoslovakia most closely approximate U.S. levels of urbanization. With the exception of Kazakhstan, the Central Asian nations are among the most rural.

Educational levels are high in many of the countries. In the FSU as a whole, 13 percent of women and 15 percent of men have at least some postsecondary education; percentages that exceed

[5] J. Sachs, *Economic Reform of Socialist Countries: Lessons and Prospects,* Ernest Sturc Memorial Lecture, SAIS, Nov. 5, 1992.

those in most European countries[6] Many in the workforce are technically trained and thus can provide the human resource base needed to support progress towards a more energy-efficient economy in the region.

The right half of Table 2-2 shows some of the ethnic characteristics of the 26 nations. All have significant ethnic diversity, which in several countries has led to problems. The former Yugoslavia, shown in the pie chart, has so far separated into five countries along ethnic lines. Czechoslovakia was about two-thirds Czech and one-third Slovak, and divided accordingly. In other countries a single titular nationality predominates, but even small minorities, as in Azerbaijan, Armenia, and Georgia have led to major unrest.

Noteworthy is the large Russian minority in many of the republics of the Former Soviet Union. With the exception of Armenia, Russian nationals comprise more than 5 percent of the population and in half the republics, they account for more than 10 percent. In three of the republics, Estonia, Kazakhstan, and Latvia, about a third of the population is Russian nationals. Highly skilled Russians were long sent to the republics as part of Soviet policy. This can be seen in the over-representation of Russians in more highly paid job sectors such as transport and industry in Latvia and Estonia whereas native workers are over-represented in the lower paying sectors.[7] In some industries in Central Asia, Russians constitute nearly all of the skilled workforce.[8]

In many republics, the status of Russian nationals, once the elite, collapsed with the collapse of the Soviet Union as republics began establishing independent national identities. The Baltic nations, for example, beginning with Lithuania in 1988, have each designated the native tongue as their official language, and in subsequent laws required knowledge of that language as one condition of citizenship for those who were not citizens before the forcible annexation of these republics by the U.S.S.R. in 1940.[9] If the response of Russian nationals to their changed status is a significant exodus (as appears to be happening in Central Asia[10]), their departure will have a particularly adverse effect on the skilled labor force, which in turn could affect how fast energy infrastructure can be upgraded and made more efficient.

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6 See table 16,5 in World Resources Institute in collaboration with The UN Environment Programme and The UN Development Programme, *World Resources 1992-1993 (New* York, NY: Oxford University Press, 1992), pp. 254-255.

7 Library of Congress, *Estonia: An Economic Profile* (Washington, DC: Library of Congress, 1992), p. 4; Library of Congress, *Latvia: An Economic Profile* (Washington DC: Library of Congress, 1992), p. 5.

8 Special Correspondent in Dushanbe, "Tajikistan in Trouble," *The Economist,* vol. *324, No. 7770,* Aug. 1, 1992, p. 31; Special Correspondent in Dushanbe, "Russian Sahibs Go Home," *The Economist,* vol. *324, No. 7771,* Aug. 8, 1992, p. 30. The author points out that one sector of the economy in Kazakhstan where Russian workers predominate is maintenance and manning weapons.

9 V. Bite, *Estonia: Basic Facts,* CRS Report for Congress 92-223 F, June 30, 1992, p. CRS-2, *Latvia: Basic Facts,* CRS Report for Congress 92-242 F, Mar. 2, 1992, p. CRS-2, *Lithuania: Basic Facts,* CRS Report for Congress, Aug. 6, 1992, p. CRS-2.

10 Special Correspondent in Dushanbe, "Russian Sahibs Go Home," *The Economist, vol. 324, No. 7771,* Aug. 8, 1992, pp. 29-30.

COUNTRY PROFILES[11]

| Poland

1989 GNP/capita $US4,500

Industrial activities: iron and steel production, extractive industries, chemicals, textiles, consumer goods, metallurgy

Natural resources: hard and brown coal, lead, zinc, large copper deposits



HISTORY

Poland has a history of occupation by its neighbors, including Austrians, Germans, and Russians, which obscured its very existence during the 19th century. Poland enjoyed a single brief and rocky period of independence, from 1918 to 1939, between the two World Wars. Soviet liberation of Poland after WWII was followed by Soviet domination.

The workers' union, Solidarity, formed in the 1970s, forced the Communist government to increase freedoms in the late 1980s after the end of martial law. In 1989, Poland became the first non-Communist-led country in the Warsaw Pact. Poland has strongly embraced democratic reforms and today is governed by a president, a prime minister, and two houses of parliament whose members are freely elected.

ENERGY

Poland has large coal reserves. Hard coal supplied about 65 percent and soft coal about 13 percent of primary energy consumption. The balance comes from oil (13 percent) and natural gas (9 percent) .12 Almost all of Polish oil is imported, in the past overwhelmingly from the former Soviet Union. Behind coal, natural gas is Poland's second largest domestic source of energy. This source has been little tapped because of lack of investment capital and limited incentives for exploration and development. Poland's reserves of high-quality hard coal have been a major source of exports, hard currency, and labor demand. In 1987, about 11 percent of the workforce was employed by the coal mining industry .13

ENVIRONMENT

Poland's history of coal use underlies its severely stressed environment. Its rivers have

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11 Agencies that compile statistics such as those cited at the beginning of each profile generally do so separately for the countries within the FSU and those that were Eastern European satellites. The statistics for the countries profiled here reflect this separation and thus are not always comparable across all countries. The sources for the introductory statistics are as follows: The World Bank, Statistical Handbook: *States of the Former USSR* (Washington, *DC: The* World Bank, 1992) for these statistics for The Baltics, Russia, and Ukraine— 1990 GDP/capita, industrial activities, natural resources; Central Intelligence Agency, *Atlas of Eastern Europe* (Washington, *DC:* Central Intelligence Agency, August 1990) for the 1989 GNP/capita in Poland, Czechoslovakia, and Hungary; *The American Academic Encyclopedia, online* edition (Danbury, CT: Grolier Electronic Publishing, updated four times yearly) for these statistics for Poland, Czechoslovakia, and Hungary—industrial activities and natural resources. For more detail on the *History* of each country see, for example, *The Academic American Encyclopedia* (Electronic Version) (Danbury, CT: Grolier, Inc., 1991). Except where otherwise referenced, the material on *Economic unpolitical Reforms* is drawn from J.S. Zacek, footnote *2.*

12 S. Pasierb, "Energy Efficiency Investment Opportunities in Poland," executive briefing, The Polish Foundation for Energy Efficiency (FEWE) and Batelle, Pacific Northwest Laboratories, January 1993.

13 U.S. Congress, Committee on Energy and Natural Resources, *Energy Profiles of Czechoslovakia, Hungary and Poland, and Their Emerging Free-Market Economies, S. Prt 102-34,* June 1991, pp. 43,48.

extremely high concentrations of toxic chemicals.[14] Coal mining has degraded and increased the salinity of agricultural land. Air pollution poses the greatest risk to human health in Poland, because of the high levels of particulate emissions associated with industry and generation of electricity. The Lenin Steelworks, 10 miles from Krakow, exemplifies the consequences of environmentally insensitive industrial practices.[15]

ECONOMIC AND POLITICAL REFORMS

Poland was the frost post-Communist country to undertake broad economic and political reforms. Reforms began in 1989 and economic ''shock therapy' began the following year with the introduction of macroeconomic reform, price liberalization, privatization of industry, removal of state subsidies, construction of a social safety net, and mobilization of international financial support.[16] Wage increases were restricted to control inflation. Restitution is being made to those who had valid claims against Communist expropriation.

Progress toward privatization has been difficult for a variety of reasons, including disagreement within the government on how to proceed.[17] In an attempt to begin privatization at the local level, citizens were encouraged to buy into enterprises owned by local governments. This did not work, partly because local government had difficulty calculating what an enterprise was ''worth' and the cost of buying into it. Moreover, both capital and entrepreneurs willing to risk buying into state-owned businesses were in short supply. What has worked, in part, has been illegal takeovers by managers of the businesses they ran ("spontaneous privatization") apparently without penalty. However, this practice ended by 1991. Other attempts to privatize include encouraging workers to buy into their workplaces at low cost, and distributing free vouchers to all citizens so they can buy into medium- and large-scale enterprises .18

Much of the privatization that has occurred to date has been through creation of new businesses. Poland needs to devise a better plan for privatizing medium- and large-scale enterprises. Foreign investors have not been interested in these enterprises because of their generally poor financial condition, outmoded technology, and old physical plant. Progress is being made in creating legal structures for broad private ownership; this should attract foreign investors who now may be reluctant to invest in a country where legal recourse is vague at best.

A second wave of reform focused on banking reform and limiting credit and tax exemptions to insolvent state enterprises. Neither has been easily implemented. New emphasis was put on foreign trade and on reorienting trade toward the West. But the push for more exports resulted in considerable opposition from management, workers' councils, and trade unions. Despite establishment of 80 private banks by September 1991, 95 percent of bank credits were granted to state enterprises. Virtually none were granted to newly established private businesses.[19]

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14 M. Glenny, *The Rebirth of History* (London, UK: Penquin Books, 1990), p. 71.

15 W. Echickson, *Lighting the Night, Revolution in Eastern Europe* (New York, NY: William Morrow and Co., 1990).

16 J. D. Sachs, *Economic Reforms of Socialist Countries: Lessons & Prospects*, The Ernst Sturc Memorial Lecture, Paul H. Nitze School of Advanced International Studies, Washington DC, Nov. 5, 1992.

17 William U. Chandler, Senior Scientist, Batelle, Pacific Northwest Laboratories, personal communication, January 14, 1993.

18 *Report on Eastern Europe,* March 22, 1991, pp. 11-13.

19 *Report on Eastern Europe,* Sept. 27, 1991, p. 25.

Benefits of the reforms to date include reducing inflation from 250 percent in 1990 to 60 percent in 1991[20], stabilizing the currency with an accompanying increase in international trade, and shifts in the supplies of consumer goods from shortages to surpluses. On the down side, the economy is in severe recession. A drop in the Gross Domestic Product of 12 percent in 1990 was followed by a 7 percent drop in 1991. Unemployment was approaching 13 percent in July 1992. Living standards are estimated to have fallen 40 percent between January 1990 and August 1992.[21]

In the October 1991 parliamentary elections, the behavior of the electorate (low voter turnout, few votes cast for the most recent prime minister, and strong support for the renamed Communist Party, which received the second highest number of votes) suggested that enthusiasm for reforms had waned. Accordingly, Poland's new government sought to slow the pace and breadth of economic reform. Yet, parliament refused to approve the government program that proposed financial assistance to failing state enterprises (estimated at 40 percent of the total), lower taxes and interest rates to stimulate production, and guaranteed prices for agricultural goods.[22] By the fall of 1992, in the wake of a number of industrial strikes, some higher wage settlements were negotiated, fueling inflation. Implementation of bankruptcy laws and breaking up monopolies seem to have stalled during 1992.

Poland's parliamentary system has suffered from a proliferation of parties. The current cabinet is composed of seven parties and has faced continual challenges maintaining a coalition. President Lech Walesa, elected by direct vote in December 1990, has sought additional authority in his effort to establish a stable government.

Both parliament and the presidency are committed to transformation to a market economy. The transformation will be aided by regulations of the International Monetary Fund (IMF), which limit the deficit in the annual state budget to 5 percent.

During the current period of high unemployment, the social safety net that has been created will need extending. The strain on the precarious state budget may be so great that foreign assistance will be needed.

NEAR- AND LONG-TERM EXPECTATIONS

Many of the elements of a democratic system and a market-based economy have been introduced very rapidly. A period of consolidation in the near term is likely in order to lock in the reforms. The economy will continue to move toward marketization, but in a mixed public/private form until large state-owned enterprises are privatized or, if failing, shut down in an orderly fashion. Poland will make the transition successfully, probably over a longer time than anticipated. Continued economic difficulties will test the fragile democratic structures and could lead to a more authoritarian system until the economic transformation has been largely completed, and perhaps thereafter.

Poland does not face the internal ethnic strife of some of its neighbors. While there are potential border disputes (stemming from World War II settlements), these are likely to be quiescent in the near term. If borders are revised elsewhere in Eastern Europe, the changes could trigger German demands on Poland's western border. Poland in turn could press Ukraine to return some land ceded to it in 1945.

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20 S. Pasierb, "Energy Efficiency Investment Opportunities in Poland," Executive Briefing, The Polish Foundation for Energy Efficiency (FEWE) and Batelle, Pacific Northwest Laboratories, January 1993.

21 J. Kim and F. Miko, *Poland, Czechoslovakia, and Hungary: Recent Developments*, Congressional Research service issue Brief IB92051, Aug. 10, 1992, p. CRS-8.

22 *Radio* Free *Europe/Radio Liberty Research Report*, March 13, 1992, *p. 45.*

I Czechoslovakia (Czech and Slovak Federal Republic, CSFR)

1989 GNP/capita: $US8,000[23]
Industrial activities: heavy industry, mining, manufacturing, construction
Natural resources: limited; brown coal, uranium, lead, copper, iron



HISTORY

With the collapse of the Austro-Hungarian Empire in 1918, the Czechs of Bohemia were united with Slovaks to form Czechoslovakia. Strong nationalist sentiments prevented union into a single people and set the stage for partition of the country. In 1938-39, Hungary and Germany annexed some lands; the remainder were made into puppet states controlled by Nazi Germany. With the end of WWII, Czechoslovakia re-emerged as a nation. A Communist coup occurred in February 1948, and shortly thereafter the country became a Soviet satellite. The short-lived "Prague Spring" of 1968 ended with Soviet intervention. Czechoslovakia remained a Soviet satellite until the peaceful fall of Communism, the so-called ''velvet revolution' in November, 1989.[24] Czech and Slovak nationalist sentiments are strong; a peaceful resolution was implemented on January 1, 1993 by division of the country into separate Czech and Slovak nations.

ENERGY

Nearly all needs for oil and natural gas are supplied by pipelines from the FSU; less than 2 percent and 5 percent respectively are domestically produced.[25] Coal reserves are extensive and are the source of more than half the country's electricity (brown coal; the smaller deposits of hard coal are used in the iron and steel industry) .26 Nuclear and hydroelectric power are also important to electricity generation, contributing 18 percent and 22 percent respectively, with six more reactors under construction (presently the total is eight operating reactors). Electric generating capacity supported modest export of electricity in 1991.[27]

ENVIRONMENT

Substantial air pollution, including SO_2, CO, NOX, and heavy metals, arises from burning coal (especially brown coal) to generate electricity. Power plants and industrial facilities are concentrated along the northern border with Germany, and increases in infant mortality rates, decreases in life expectancy, and other health problems have been reported. Air pollution in Czechoslovakia contributes significantly to degradation of Central European soil, water, and forests, which has focused international attention on the problem.[28]

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23 While the GNp/Capita figure for Czechoslovakia is almost twice that given for Poland, this does not mean the standard of living in Czechoslovakia is twice that in Poland because the values are confounded by exchange rate variations and other problems associated with data collection. William U. Chandler, Senior Scientist, Batelle, Pacific Northwest Laboratories, personal communication Jan. 14, 1993.

24 J. Kim and F. Miko, *Poland, Czechoslovakia, and Hungary: Recent Developments*, Congressional Research Service Issue Brief IB9205 1, Aug. 10, 1992, p. CRS-10,

25 U.S. Department of Energy, *US Industrial Briefing Book: US Electric Power Technologies conference*, Czechoslovakia, July 1992.

26 Royal Dutch Shell Group, The Shall Briefing Service, *Energy in the Soviet Union and Eastern Europe*, London, 1991, p. 9.

27 U.S. Department of Energy, Op. cit.

28 Ibid.

ECONOMIC AND POLITICAL REFORMS

Czechoslovakia was slower to start economic reform than Poland and Hungary, but then embarked on a strong program in 1991. Like the other two, Czechoslovakia's program includes macroeconomic stabilization, privatization, liberalizing prices, and currency convertibility and has had the same near-term consequences of price increases, unemployment, and productivity declines.[29] Successes include establishment of a convertible currency, the koruna; privatization of more than half of all small businesses in 1991; and reorientation of trade to the west. Germany has surpassed the FSU as the largest export market. Consequences have been greater for Slovaks than Czechs (e.g., an unemployment rate of 12 percent compared to 5 percent in Czech areas at the end of 1991), largely because of closure of plants to manufacture arms, which were disproportionately located in Slovakia.[30]

Demonopolization legislation was one of the first steps towards reform undertaken in Czechoslovakia. By late 1990, small businesses were being auctioned and entrepreneurs were encouraged to start their own businesses (although legal and financial support had not yet been put in place). Unemployment payments and mandatory training for laid-off workers were legislated;[31] both federal and republic governments were to provide some of the funding, and state and privatized businesses the remainder.

Reformers counted heavily on a voucher system to encourage citizens to support and participate in privatization. Voucher holders have been urged to buy into mutual investment funds, which have bought shares in state-owned enterprises. Data are not yet available on the extent to which this process has been implemented.

Because Czechoslovakia is a federal system, much of the authority to implement legislation pertinent to economic transformation devolved to the Czech and Slovak republics. While the major public policies regarding marketization were drawn up at the federal level, it largely remains for the republics to implement them. Slovakia has experienced greater economic dislocation, higher inflation, and higher levels of unemployment than the Czech republic. Slovak leaders have called for a slowing of reforms. Their government has taken a more central role in the economy than in the Czech republic.

The June 1990 parliamentary elections created the basis for a democratic system. A second round of elections (again both at the federal and republic levels) was held in June 1992. The results led to the Slovak desire for independence, and the Czech republic agreed.

NEAR-TERM EXPECTATIONS

In the near term, Czech economic transformation is likely to continue. Economic dislocations have been less severe than elsewhere, and the 1992 elections indicated wide support for continued reform. Encouragement of foreign investment will likely increase. Foreign trade will move towards the central Danube and the west.

Economic relations between the two republics may remain collaborative, based on past practice of operating as a single economic unit. The two republics will not erect customs barriers, as stipulated by the European Community (EC) as a condition for its recognition of both countries as associate members in the Community. Czech trade may draw away from Slovakia as the Czech republic increasingly orients to the west. Slovakia is likely to maintain more traditional trading relationships.

Slovakia will move more slowly toward marketization than its Czech neighbor, and the government will play a more substantial role in the

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29 J. Kim and F. Miko, *Poland, Czechoslovakia, and Hungary: Recent Developments*, Congressional Research Service Issue Brief IB9205 1, Aug. 10, 1992, p. CRS-2.

30 Ibid., pp. 11-12.

31 *Report on Eastern Europe,* July 5, 1991, p. 8.

Slovak economy. The country will likely focus substantial attention on building an independent state; policies of building national identity may run counter to the country's economic interests.

LONG-TERM EXPECTATIONS

The Czech republic is likely to succeed in its transition to a market economy and will strengthen its democratic political structure as well. German economic influence followed by domination is a distinct possibility. Czech political leaders currently perceive this possibility to be a consequence of both geographic proximity and the need for foreign capital during the transition period rather than a threat.

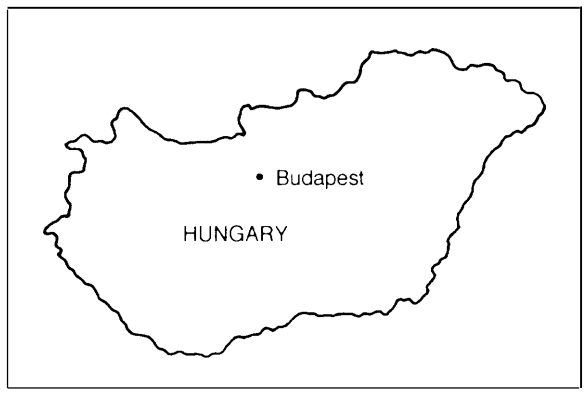
Slovakia may believe its economic interests are tied to closer relations with the Czech republic and may seek to develop them. Czechs are likely to agree, but continued public/private ownership within the Slovak economy may make close collaboration difficult. Slovakia may also face difficulties with its large (12 percent) Hungarian minority if it is not attentive to minority rights. Hungary may choose to press the Slovak government for better treatment of Hungarians or, potentially, for border revisions. If Slovakia feels its independence is threatened, it may permit a more authoritative political system.

| Hungary

1989 GNP/capita: $US6,000
Industrial activities: manufacturing, construction, engineering, pharmaceuticals, chemicals
Natural resources: limited; some bauxite, coal, iron, uranium, oil, and natural gas

HISTORY[32]

Hungary traces its beginning to the migration of the Magyar people from Western Asia in the ninth century. It was a battleground between Turks and Austrians for 200 years, eventually becoming part of the Austro-Hungarian monarchy in the 19th century. After the monarchy was defeated with Germany in World War I, Hungary lost well over half its territory. World War II brought complex relationships with Nazi Germany and the beginning of Soviet control. In the 4 years beginning in 1945, elections changed from free to a single slate of Communists or CP sympathizers; by 1949 control was complete. In 1956, a student demonstration sparked a revolution that required Soviet intervention to quell. Attempts at economic reform (see below) initiated in the 70s and 80s stimulated attempts at political reform that accelerated in the late 80s as the Communist Party was increasingly under attack. Free multiparty elections were held in March 1990 and Communism was defeated. Political fragmentation from myriad small parties was prevented by a requirement that a party receive at least 4 percent of the popular vote, a criterion agreed on in pre-election discussions. Other supporting actions gave Hungary a stable political framework within which to develop a market economy.



ENERGY

Domestic production of crude oil and natural gas supplies about 40 percent of primary energy needs. About half of domestically generated electricity (and a third of total supplies) comes

32 Sources for the History and Economy sections are: J. Zacek, footnote 2; I. T. Berend, "Hungary: Eastern Europe's Hope?" *Current History*, vol. 91, No. 568, pp. 381-384; Central Intelligence Agency, *World Factbook 1991* (Washington DC: Central Intelligence Agency, 1991); *The Encyclopedia Americana: International Edition* (Danbury, CT: Grolier, Inc., 1986).

from the Paks nuclear power station located south of Budapest, a station considered one of the region's most safe and efficient. About a quarter of electricity is imported. The balance depends almost entirely on thermal generation using coal, oil and gas, especially coal. Hydro supplies a tiny fraction (less than 1 percent) .33

ENVIRONMENT

Environmental degradation in Hungary is great, largely due to many years of generating electricity from indigenous high-sulfur (brown) coal.

ECONOMIC AND POLITICAL REFORMS

As in political reform, Hungary's approach to economic reform has been more gradual and methodical than in the other satellite nations. The country's economy was healthier than the economies of Poland and Czechoslovakia when reforms began in earnest. Changes dating back to 1968 reduced central planning, began marketization of the agricultural sector, and moved the economy towards decentralization, market pricing, and privatization. By the mid 1980s, private or semiprivate firms primarily in agriculture, services, and construction produced about a third of the GNP. Small-scale privatization has been brisk, but medium- and large-scale enterprises remain largely state owned.[34] By 1992, the National Bank of Hungary had been granted autonomy from state control; it is to supervise the commercial banking system and accelerate loan availability to privatizing and privatized businesses. Besides a slower approach to privatization, there has also been greater reliance on foreign investment in Hungary. Unemployment has leveled off at 6 to 7 percent. There is a limited social safety net, but an estimated 30 percent of the population lives at or near poverty levels because of continued inflation and low wages.[35] Other problems are outmoded capital plant, a GNP that declined by 1 percent in 1989 and about 6 percent in 1990, and foreign debt that has doubled (to more than $20 billion) since 1985.

Hungary's political system has been quite stable since the free elections for parliament in the spring of 1990. The ruling coalition has retained power, and there has been a single prime minister since the elections. Thus far, the prime minister and cabinet have directed the legislative agenda, and efforts to create a strong presidency have not emerged.

NEAR- AND LONG-TERM EXPECTATIONS

In the near term, Hungary is likely to continue its measured pace toward a market economy. Once the reprivatization claims have been settled (restitution), the State Property Agency will turn its attention to new privatizations. More favorable tax laws for private ownership as well as bank credits should encourage greater domestic investment, and the country should continue to attract foreign investors.

Parliamentary elections are scheduled for 1994. The Hungarian Socialist Party (formerly the CP) will probably do better than the 10 percent of the vote it received in 1990. The main opposition party, the Alliance of Free Democrats, may fare better too, because of popular dissatisfaction with continued decline in living standards. The Democratic Forum, leader of the current coalition, may be held responsible for present difficulties. The Alliance initially favored a more rapid approach to marketization and has been critical of the cumbersome reprivatization process.

Hungary's small size geographically and demographically (10.6 million people) may make the transition process less difficult than in larger countries. Hungary's minority populations are not likely to present major internal strife. The country stated concern for Hungarians living

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33 Nuclear Engineering International, *Datafile Hungary*, vo1. 37, No. 452, pp. 50, 51.

34 *Radio* Free *Europe/Radio Liberty Research Report,* Jan. *24, 1992,* p. *43.*

35 *Business Eastern Europe,* Aug. 3, 1992, p. 380.

elsewhere (Slovakia and Romania) could result in boundary disputes.

In the longer term, Hungary will manage the economic transition successfully. If parliament develops a more focused approach to consideration of legislation, an authoritarian system maybe avoided.

| The Baltics (Estonia (E), Latvia (La), and Lithuania (Li)

1990 GDP/capita (current rubles): 5,039 (E), 4,542 (La), 3,561 (Li)

Industrial activities: fish & fish products, textiles, furniture (E); machinery, food products, textiles, chemicals (La); machinery and parts, processed foods, light industrial products (e.g., textiles, apparel, furniture, household appliances) (Li)

Natural resources: limited-timber, oil shale, limestone (E); peat, dolomite, limestone, gypsum, amber, gravel, sand (La); agricultural land, forests (Li)

HISTORY[36]

In the last several hundred years, the autonomy of the three Baltic countries of Estonia, Latvia, and Lithuania has been compromised by invading Germans, Poles, Swedes, and Russians. In 1918 the Baltics achieved independence, only to lose it under forcible annexation by the U.S.S.R. in 1940. Fifty years later, Lithuania was the first of the three to declare independence from the Soviet Union, on Mar. 11, 1990. Estonia and Latvia followed on Aug. 20 and 21, 1991 during the Soviet coup attempt that began Aug. 19, 1991. Shortly thereafter the international community recognized all three as independent countries. (U.S. recognition came on Sept. 2, 1991.) Each of the three countries is now governed by a parliament (the Supreme Council) for legislative functions and by a Prime Minister and set of departmental ministers for executive functions.



ENERGY

Of the three, only Estonia has a significant energy resource, oil shale, which supplies most of its energy needs. Latvia meets some of its energy needs with hydroelectric power; plants on the Daugava River generate a third of the country's electric power. Most of Latvia's energy comes from Estonia and other countries. Some oil and natural gas deposits occur in Lithuania, but the country meets most of its energy needs by importing these fuels and from its large nuclear power generator near Ignalina.

ENVIRONMENT

Soviet economic policies brought pollution of Baltic air, water, and soil. Although the Baltic countries took action in the 1980s to limit further damage, a great deal of expensive and difficult environmental cleanup remains to be done.[37]

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[36] For this and the following text on the Baltics, see V. Bite, *Estonia: Basic Facts, Latvia:* Basic *Facts,* and Lithuania: *Basic Facts,* CRS Reports for Congress 92-223 F (June 30, 1992), 92-242 F (Mar. 2, 1992), and 92-313 F (Aug. 6, 1992) respectively. Also *The American Academic Encyclopedia, online* edition (Danbury, CT: Grolier Electronic Publishing, updated four times yearly), and Library of Congress, *Estonia: An Economic Profile,* and *Latvia: An Economic Profile,* July 1992 and August 1992, respectively.

[37] V. Bite, *The Baltic States: U.S. Policy Concerns,* CRS Issue Brief IB90075, Sept. 29, 1992, p. CRS-8.

ECONOMIC AND POLITICAL REFORM

GDP/capita is greatest in Estonia, least in Lithuania. The countries have limited natural resources; Estonia is the most resource rich and most industrialized. All were heavily integrated into the Soviet economy which supplied raw materials and provided markets for goods. The disintegration of the Soviet Union has disrupted the supply of raw materials with consequent loss in economic production and in the standard of living.

Until recently, all continued to use the ruble as currency. In June, 1992, Estonia became the first of the Baltics to establish its own currency, the kroon.

While there are differences in the manner and speed with which the three have set about creating market economies, common patterns emerge. All moved quickly to strengthen and broaden earlier reforms that had been partially put in place (freeing prices, ending state subsidies) before independence. Many of the same strategies employed elsewhere have been followed in the Baltics.

Privatization of small businesses and services has proceeded steadily. Outside the small business and service sectors, privatization has been slow to occur, in part because restitution claims are being processed slowly. Estonia has had some success encouraging foreign investment; the other two republics were initially reluctant to permit 100 percent foreign ownership, but they now do. Bank credit decisions still favor state-owned businesses. Foreign trade is being successfully reoriented toward Finland, Sweden, and Germany, although the Baltics are still tied to nearby Russia for raw materials and for sale of some finished goods. Estonia's new currency is based on the German mark, and the other two are scheduled to introduce their own currencies, which will not be based on the ruble either. The three currencies will be stabilized by the International Monetary Fund and partially backed by gold. Lithuania has introduced a voucher system to stimulate privatization of medium- and large-scale enterprises, and Latvia plans to do the same (although implementation needs to be worked out).[38]

Politically, democratic systems are being restored. Competitive parliamentary elections were held in spring 1990 and many non-Communists were elected to office. Both Estonia and Lithuania held a second round of elections in fall, 1992. Right of center parties formed the new governing coalition in Estonia, continuing support of the reforms. In Lithuania, the governing coalition, led by former Communists, is committed to reform but at a slower pace. Political parties have become more organized and parties are building support within the electorate. Other democratic reforms are being put in place.

NEAR- AND LONG-TERM EXPECTATIONS

In the near term, the Baltics are likely to strengthen democratic institutions. They will continue the marketization process, but probably more slowly (certainly in Lithuania). They will establish currency convertibility, will continue to reorient their trade towards the west, and will probably apply for EC associate status.[39] The Baltics are likely to create a customs union and work collaboratively to bolster their economies.

Estonia and Latvia have large Russian minority populations and are likely to treat these populations carefully, as the Russian government has expressed concern over their treatment. Russian troop withdrawals have been halted and economic sanctions could be imposed.

In the longer term, the Baltics are likely to reestablish themselves as independent, democratic, market-based countries whose place in Europe is secure. They will be EC associate

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38 *Business Eastern Europe,* July *27,* 1992, p. *367.*

39 There is a 10-year agreement between the Economic Community and its associate members. In the first 5 years, *the* EC reduces its tariffs on nonagricultural goods. Associates follow suit in the second 5 years.

members and will seek regular membership. They will continue trade relations with Russia and other ex-Soviet countries. The Russians who opt to remain in Estonia and Latvia (and most will) will have satisfied citizenship requirements. Latvia's lengthy residence requirement for non-Latvians prior to citizenship may be revised downward. If an authoritarian Russian regime emerges, it will likely try to extend its political and economic influence over the Baltics, which could limit the options of these nations.



Russian Republic

1990 GDP/capita (current rubles): 4,224
Industrial activities: oil, natural gas, machinery, chemicals
Natural resources: coal, oil, natural gas, diamonds, gold, phosphorites, potassium salts, uranium

HISTORY[40]

200 years of Mongol rule over a collection of principalities that partially overlapped what is Russia today ended when the prince of the principality of Moscow declared himself Tsar (ruler) of all Russia in 1481. Successive tsars expanded the empire until the overthrow of Nicholas II in 1917, Shortly thereafter, the Bolsheviks consolidated power and forcibly reincorporated into the new U.S.S.R. the nations of the former Russian empire (such as Georgia and Ukraine) that had enjoyed a brief period of independence after the Tsar's demise. A succession of leaders; Lenin, Stalin, Krushchev, and Brezhnev between 1917 and 1982, established and refined Communist rule but were unable to correct increasing economic problems. Mikhail Gorbachev was the last to attempt economic reform within the structure of the Communist Party. The U.S.S.R. came to an end in December 1991 and its 15 republics, including Russia, have since sought and received international recognition of their independence.

ENERGY

Russia is the world's largest producer of oil, primarily in Western Siberia, with export to Eastern Europe mainly by pipeline and to Western Europe via tankers. Russia contains the world's largest reserves of natural gas, with production also concentrated in Western Siberia. Gas is exported to Europe by pipeline. Russia also has coal reserves and produced more than half of all Soviet coal.[41]

ENVIRONMENT

Radioactive waste, including radioactive pollution of ground water, is one of many environmental problems in Russia.[42] High levels of air, water, and soil pollution occur in many regions. Many coastal waters are highly polluted, including those of the White, Barents, and Kara Seas, the Pacific and Arctic Oceans, and the Gulf of Finland. Agricultural and industrial pollutants have eliminated nearly all fish in the Sea of Azov and the fish in the Caspian Sea are similarly threatened.[43]

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40 See J. Nichol, *Russian Federation: Basic Facts,* CRS Report for Congress 92-137 F, Feb. 6, 1992.

41 U.S. Department of Energy, Energy Information Administration, *EIA Analysis Brief: The Former Soviet Republics.*

42 M. Feshbach and A. Friendly, Jr., *Ecocide in the USSR: Health and Nature Under Siege* (New York, NY: Basic Books, 1992), pp. 175-176.

43 R.A. Mnatsakanian, *Environmental Legacy of the Former Soviet Republics,* Center for Human Ecology, Institute of Ecology and Resource Management, University of Edinburgh, 1992.

ECONOMIC AND POLITICAL REFORMS

In 1991 GDP fell by 17 percent and consumer prices rose 140 percent, precipitating the collapse of the Soviet economy and the end of the U.S.S.R. The transition to a market economy and to building a democratic political system is proving much more difficult in Russia than in the countries just reviewed (with the exception of Slovakia). Part of the problem is that Russia has not fully committed to political reform, and this in turn has limited economic reform. Many of the CP apparatchiks remain in positions of power politically and economically and would like to slow the pace of reform, if not return to the old status quo. Nonetheless, President Yeltsin initiated an economic reform program in the fall of 1991 and intensified it in January 1992. Recent (December 1992) Yeltsin setbacks with the Congress of Peoples' Deputies have dimmed prospects for Yeltsin's programs.[44]

Economic czar Yegor Gaidar (former Minister of Finance and acting Prime Minister) sought to implement a form of 'shock therapy' similar to Poland's, with many of the same elements. Less than widespread commitment to a program of rapid change has helped limit the effectiveness of ''shock therapy'' in Russia. The battle over the speed of reform is tied to issues of political structure: will Russia preserve and strengthen its current strong presidency or will parliament become the dominant institution in political affairs? Most of the relevant statutes promoting rapid economic transformation have been issued as executive decrees rather than emerging from parliamentary processes.

Russia has received IMF approval for its reform plans, although its current budget deficit is beyond IMF-established limits; adjustments will be needed before additional loans are forthcoming. Russia has substantial foreign debt (inherited from the U.S.S.R.), and the debt service needs to be renegotiated and rescheduled.[45]

Thus far, privatization outside the service and retail trade sectors has scarcely begun. There is limited domestic capital available, and the government has not decided whether it wants to encourage substantial foreign investment and how best to do so. (100 percent foreign ownership is still prohibited.[46]) The State Property Agency, granted extensive authority as the key agency for privatization, was charged in July 1992 with acting as creditor for state enterprises with significant debt. The size of interenterprise debt is estimated at 3.3 trillion rubles.[47]

Gaidar's reform package called for creation of a social safety net to provide a cushion against severe economic dislocations, but there is little evidence that much funding has been provided. The voucher system has been announced, but mutual investment funds have not yet been set up nor have state enterprises been organized as joint stock companies.[48] Overall, there was little new or different in the Gaidar plans from what has been proposed and adopted in the countries surveyed above.

What is different is the sheer size of Russia geographically and demographically, the extent of opposition to ''shock therapy' reform on both the central and local levels (although some localities have moved toward privatization faster than the central government), and the anti-Russian hostility of small ethnic groups that comprise the Russian Federation (including several republics that refused to sign the Treaty of

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44 See S. D. Goldman, Russia, CRS Issue Brief, IB92089, Aug. 3, 1992; and J. D. Sachs, *Economic Reforms of Socialist Countries: Lessons & Prospects, The* Ernst Sturc Memorial Lecture, Paul H. Nitze School of Advanced International Studies, Washington DC, Nov. 5, 1992.

45 Keith Bradsher, ''Turmoil in Europe; Talks on Rescheduling Moscow's Debt Pit U.S. and Russia Against Germany, ' 'The New *York Times*, Sept. 21, 1992, p. A9.

46 ''What's New In Your Industry CIS,'' *Business Eastern Europe*, Sept. 14, 1992, p. 450.

47 *Foreign Broadcast Information Service*, Nov. 14, 1992, *p.* 12.

48 Celestine Bohlen, "Citizens of Russia To Be Given share of State's Wealth,'' *The New York Times*, Oct. 1, 1992, p. Al.

Federation and claim independence). There is also a notable lack of the supervisory authority that the central government wished to establish over the provinces and localities but has been unable to achieve.

Russian reformers have introduced many reform elements without taking time to devise appropriate implementation strategies. There is less consensus for reform than in the other countries discussed in this section, with the exception of Ukraine (see below). No East European leader found it necessary to request or receive emergency powers, as Yeltsin did. Granted by parliament for one year, these powers ended in December 1992. It seems unlikely that parliament will agree to extend them, in light of the institutional struggle between it and the presidency.

NEAR AND LONG-TERM EXPECTATIONS

In the near term, Russia is likely to slow the pace of transformation. Civic Union, an umbrella organization of groups of industrialists, trade unions, and several political parties, favors a slower approach but not a reversal of reforms. One component, the Union of Industrialists and Entrepreneurs, has called for greater financial support for state enterprises and reinstitution of some price controls at this phase of the transition .49 Directors and managers at the enterprise level are pressing for a slowdown as well. The military industrialists, who oppose conversion of military factories to civilian use, support the go-slow approach at best. So do the professional military who prospered under the old system.

The reform leadership will continue to contend with-right wing Russian nationalist groups, dissatisfied ethnic minorities, regional pressures for autonomy in a newly decentralized system (in Siberia, in particular, with its vast resources), and opposition from the old Communist-controlled bureaucracies that still operate within the ministries, the banking system, the state-owned sector, and elsewhere. All of these will act as brakes on the reform process.

Political strife is likely to hamper economic reforms whatever is the outcome of the current crisis. Yeltsin may remain for the immediate period but has declared that he will not be a candidate for election when his term is up (but he could change his mind). The future course of establishing a functioning democracy will be affected greatly by Yeltsin's successor. Thus far, implementation of democratic reforms has been limited: local elections have been postponed, independent newspapers find it difficult to obtain newsprint, and substantial self-censorship is still practiced. Political parties are still in formation and are not yet grounded in the electorate. Reforms in the 1egal structure and judicial system are just getting underway. With continued economic difficulties in addition to the special problems cited above, a reversion to authoritarian rule is a distinct possibility.

At best, Russia will establish some form of mixed economy in the near term, some private, some cooperative, and a majority still state-owned. Unless Russia can attract substantial foreign assistance directly tied to privatization, modify its legal and tax framework to support privatization, and create a climate favorable for foreign investment, the capital needed to privatize and modernize its industrial plants will not be available.

In the longer term, a limited democracy at best is likely to emerge. The desire to keep the country together and to continue as a significant power in Europe and Asia will encourage strong central leadership. That leadership will need military support and may not be tolerant of organized opposition. The tradition of a strong state role in the economy (which was a feature of 19th century Russia as well as the Communist experience) may carry on. Russia is likely to continue to have a mixed public/private economy and may well not

49 Celestine Bohlen, "Sliding Ruble Seen As Omen of Another Price Explosion, " *The New York Times,* Sept. *5,* 1992, p. *3.*



establish predominately private ownership in the industrial sector.

Ukraine

1990 GDP/capita (current rubles): 3,177
Industrial activities: heavy industry, food processing
Natural resources: agricultural land, bitumen, hard coal, natural gas, oil, iron ore, manganese, uranium

HISTORY[50]

With its declaration of independence on Aug. 24, 1991, and ratification of that declaration in a referendum approved by a 90 percent majority on December 1, 1991, Ukraine became a sovereign nation for the frost time in centuries. Previously it was partitioned in various ways by Poland and Russia and by Russia and the Hapsburg Empire. There was also a period of occupation by the Nazis beginning in 1941. Soviet occupation under Stalin was particularly brutal; a Soviet-engineered famine when Ukraine resisted collectivization of agriculture killed millions in 1932-33.

Besides ratifying independence in December, voters elected a president, former Communist leader Leonid Kravchuk. The Ukrainian Supreme Soviet (parliament) was formed after competitive elections in 1990.

Major disagreements exist between Ukraine and the Russian republic. One concerns control of nuclear weapons. Ukraine, Russia, Kazakhstan, and Belarus are the four republics that were sites of nuclear weapons in the former Soviet Union and remain sites of such weapons today. Another disagreement is the disposition of the Black Sea fleet. A third is the Crimea where two-thirds of the population is Russian and where support for independence dropped to 54 percent in the December vote.

ENERGY

The largest coal producing area in the FSU is the Donets Basin in Ukraine .51 Nonetheless, natural gas is the most widely used energy source in the country, accounting for 41 percent of total energy consumption in 1991 (compared to 31 percent for coal). Domestic gas production lags consumption and gas is imported, typically from Russia and Turkmenistan.[52]. Nuclear energy is also important, and was the basis of 25 percent of total electric power generation in Ukraine in 1991. Oil needs are heavily dependent on imports; in 1991, less than 10 percent of oil required was domestically produced.[53]

ENVIRONMENT

Ukraine has severe environmental problems. One such is radioactive contamination. Chernobyl left 180 tons of radioactive fuel encased in

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50 See s. Woehrel, *Ukraine: Basic Facts*, CRS Report for Congress, 92-138 F, May 14, 1992; *Ukraine*, CRS Issue Brief, IB92072, July 24, 1992; and *The Amen"can Academic Encyclopedia, online* edition (Danbury, CT: Grolier Electronic Publishing, updated four times yearly).

51 Energy Information Administration, *EIA Analysis Brief: The Former Soviet Republics,* Sept. 1991.

52 I. Yukhnovskiy, ''What Are We-Rich or Poor? On the Question of Reorganizing the Structure of Production in Ukraine,' *Vercherniy Kiyev*, *Kiev, Ukraine, May 19, 1992,* pp. 3-4.

53 US Department of Energy, *US Industrial Briefing Book: US Electric Power Technologies Conference*, ''Ukraine,'' July 1992.

concrete walls up to 59 feet thick, as well as at least 50,560 square miles contaminated with Cesium- 137.54 The major rivers carry raw sewage, agricultural chemical runoff, and industrial waste to cities such as Odessa and on to the Black Sea, which is in danger of eutrophication .55 The level of air pollution from factories in part of southeastern Ukraine has been described as "catastrophic."[56]

ECONOMIC AND POLITICAL REFORMS

Of the FSU, Ukraine's economic potential is second only to Russia. Ukraine accounted for 16 percent of the total GNP of the Soviet Union in 1991, and is rich in both mineral and agricultural resources. Steel production and coal mining are major industries and the manufacturing base is well-developed and diversified, producing machinery, industrial equipment, and chemicals. Often referred to as the breadbasket of the FSU, Ukraine produces quantities of grain and sugar beets.

A coupon currency system, somewhat parallel to the ruble, was introduced in January 1992. There is disagreement on how rapidly to proceed on economic reform, with rival plans under consideration; progress so far is slow.

Price controls have been lifted only partially and privatization legislation is not yet in place. Russian officials have urged Ukraine to lift price controls because cheaper Ukrainian goods are being sold in Russia, while Russian goods are left unsold on shop shelves.[57] Ukraine plans to lift price controls slowly. The country has begun to seek foreign investment, having put some tax incentives and registration regulations in place, but successes are limited. Most of the reform elements described earlier have not yet been legislated or, if legislated, have barely gotten under way. Ukraine has not yet produced a marketization plan and a state budget satisfactory to the IMF and is not yet eligible for assistance through that organization. Clearly, Ukraine's leaders have chosen a slow pace to economic transformation.

Politically, a partial democratic structure has been put in place. The current parliament was elected in spring 1990 and still has a number of ex-Communists in it. Both the current and previous prime ministers are ex-Communists who held important positions prior to 1992. President Leonid Kravchuk, elected by direct popular vote in December 1991, was second secretary of the Ukrainian CP until he resigned his membership after the August 1991 coup attempt. He joined the movement for national independence in 1991. Despite the country's measured approach to reforms, parliament recently secured the resignation of a prime minister because the pace of economic reform under his guidance was too slow at the same time that the economy was continuing to deteriorate.[58]

Ukraine wants to avoid return to Russian domination and seeks to align itself with the Central European countries considered here. To avoid provoking Russia, Ukraine has been careful thus far to attend to the concerns of its 20 percent Russian minority.

NEAR- AND LONG-TERM EXPECTATIONS

In the near term, Ukraine is likely to target a mixed public/private economy, with the state continuing to have a major role. The pace of reform is likely to remain slow, IMF membership will be granted once a satisfactory budget is in place and assistance will be forthcoming. Ukraine will continue to seek foreign assistance and will create the necessary legal and financial fiame-

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54 M. Feshbach and A. Friendly, Jr., *Ecocide in the USSR: Health and Nature Under Siege* (New York, NY: Basic Books, 1992), pp. 146-7.

55 Ibid., pp. 124-125.

56 Ibid., p. 93.

57 Business *Eastern Europe,* Sept. 28, 1992, p. 474.

58 Special Correspondent, "Arms Maker Is Named Premier By Ukraine," *The New York Times,* Oct. 14, 1992, p. A7.

work to attract foreign capital, which in turn may help to speed up the reform process.

Relations with Russia could deteriorate over military issues (the Black Sea Fleet, which the two nations agreed to control jointly in 1992; Ukrainian reluctance to hand over nuclear weapons to Russia; the size of the Ukrainian military) and territorial issues (the autonomy of Crimea and Russian insistence on its return; Crimea was ceded to Ukraine in 1954 by the Soviet government without Russian government approval). There will be economic difficulties between the two (insistence on payment for imports with hard currency only, possible creation of tariff barriers, unwillingness to supply needed resources, including Ukrainian agricultural goods). While these disputes are not likely to degenerate into military confrontations, they may strengthen the case for a strong executive and pave the way for authoritarian rather than democratic rule in the interests of national security.

Over the long term, political transformation to democracy will likely remain incomplete because of belief that a strong central government and strong executive is essential to preserve independence. Economic transformation to a market economy is also likely to remain limited as the government will maintain a strong presence in the economy and at best will support a mixed public/private ownership system.

Energy Supply and Demand: An Overview 3

For many years, energy production was a cornerstone of centrally planned economies of Central and Eastern Europe (CEE). Leaders relied on expanding energy supplies to foster rapid industrialization, particularly of heavy industries. In fact, energy production fueled an impressive economic growth rate in the former Soviet Union (FSU), averaging 5.8 percent annually between 1950 and 1989. During this period, energy supplies increased six times (averaging 4.7 percent/year).1

Despite the increase in energy supplies, the FSU experienced several slumps in energy output. Each time, authorities reacted to the situation by throwing more money and resources at the problem. For example, in the early 1980s, when oil production declined, the Soviets increased funding for development drilling, substituted natural gas for oil, and accelerated their nuclear power program to fill the gap. Few efforts were made to conserve energy supplies or to use energy more efficiently.

These supply-oriented solutions required the massive infusion of capital resources. During the 1970s and 1980s, annual investment in energy industries doubled every 10 years. In 1988, capital investment in energy industries accounted for 15 percent of the total Soviet budget and 40 percent of all industrial investment.2

The tremendous increases in energy production investment, however, did not result in commensurate gains in supply. While capital outlays grew 105 percent between 1980 and 1988, the amount of energy produced rose by only 23 percent.[3]



Larry Markel

Oil shale plant in Estonia.

[1] United Nations, Economic Commission for Europe, *Energy Reforms in Central and Eastern Europe--The First Years,* ECE Energy Series, No. 7 (New York, NY: United Nations Publications, 1991), p. 5.

[2] Central Intelligence Agency, Directorate of Intelligence, *Soviet Energy Data Resource Handbook, SOV-9O-1OO21, May 1990,* p. 15.

[3] Ibid.

Over the last two decades, capital investment among FSU energy industries shifted in several important ways that favored oil production over other energy sources and over other sectors of the economy. In 1970, the oil industry received 30 percent of total energy investment; its share grew to more than 50 percent in 1988.[4] Moreover, the allocation of capital was geographically imbalanced. Capital flowed mainly into one province, the Tyumen Oblast in Western Siberia, contributing to capital shortages elsewhere. Investment in Ukraine and other areas west of the Urals declined or stagnated. Finally, the emphasis on oil production resulted in the neglect of oil and gas exploration, a decline in coal output, and a slow down in the expansion of electrification.[5]

Given the emphasis placed on energy production and related capital investment strategies, plus low energy prices, it is not surprising that energy conservation practices were largely ignored. As a result, countries of the FSU are among the most energy intensive in the world. In 1985, energy intensity, defined as the ratio of primary energy consumption to GNP,[6] in the FSU was about 37 percent higher than the U.S. ratio and more than twice as high as Japan's.[7] In 1990, the FSU's energy intensity was 70 percent higher than the United States and about 2.5 times that of Western Europe. The gap is especially evident in the industrial sector where energy use per unit of output was 3 times higher than in the U.S. and 3.5 times higher than in Western Europe.[8] Low energy prices, the structure of the industrial sector, and the slow rate of technological improvements are largely responsible for the sector's high energy intensity.

There are enormous opportunities to save energy in this region. Russia's potential is one of the greatest in the world. Recent economic reforms and structural shifts will have a strong influence on energy use. Throughout the region, energy prices have increased substantially over the last year, and further increases are certain. Technology also will have a significant impact on energy efficiency. One expert estimated that replacing energy-using technologies in the FSU with Western European models could lower intensity by 25 to 40 percent.[8] For a more detailed discussion of energy savings potential by sector, the reader is referred to chapter 4.

Improving energy efficiency will have enormous environmental benefits as well. This region is responsible for about 20 percent of carbon dioxide emissions worldwide and most of Europe's SO_2 emissions.

ENERGY SUPPLY PICTURE

The former Soviet Union commands a large share of the world's total energy supplies. How these supplies are developed and utilized will influence global energy markets in the future. It is likely that Europe will require substantial energy imports to meet growing domestic demand. Much of these imports will come from the FSU.

Russia, in particular, has great oil and gas resources. Other former republics, such as Ukraine, have substantial coal reserves. Of the Central

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4 Ibid.

5 Leslie Dienes, "The Energy System and Economic Imbalances in the USSR," *Soviet Economy,* vol. 1, No. *4, 1985,* pp. 340-372

6 Caution must be used when estimating primary energy consumption to GNP in CEE countries. For example, much of CEE countries' historical economic data are based on plans rather than on actual output. Moreover, the value of nonconvertible currencies is difficult to translate into meaningful economic output. Structural differences in the economy, output mix, and climatic differences effect energy intensity as well.

7 Albina Tretyakova and Matthew Sagers, "Trends in Fuel and Energy Use and Programmes for Energy Conservation by Economic Sector in the USSR," *Energy Policy, vol. 18,* October 1990, p. 726.

8 Igor Bashmakov, "Energy Conservation Costs and Benefits for Russia and the Former USSR," Moscow Center for Energy Efficiency, Visiting Scientist, Pacific Northwest Laboratory, Battelle Memorial Institute, April 1992, p. 6.

9 Lee Schipper, ''Improving Energy Use in the Soviet Union: Opportunities for the West?, ' paper prepared for the Fritjiof Nansen Institute, Oslo, January 1992, p. 4.

European countries, only Poland has large energy resources, mostly coal. The following provides a brief description of energy supplies in the FSU, Hungary, Poland, and the former Czechoslovakia (CSFR).

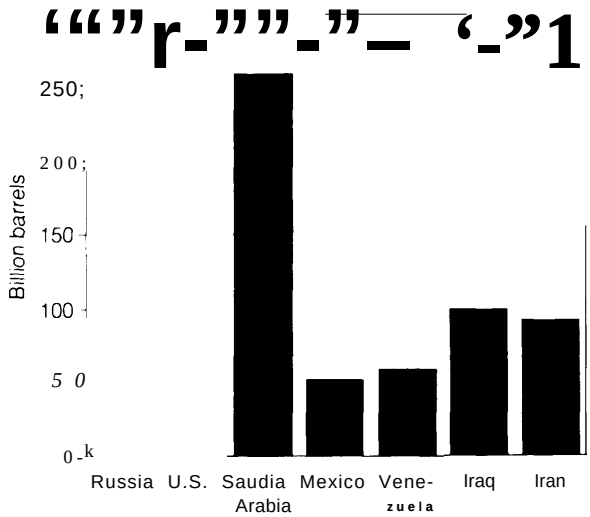
Oil

RESERVES

The former Soviet Union is rich in oil reserves, In 1990, the FSU had proven oil reserves of 57 billion barrels (B/bls), which is about double that of the United States, but dwarfed by Saudi Arabia's 260 B/bls. (See figure 3-l.) The potential for new oil discoveries is great. The U.S. Geological Survey (USGS) estimates that undiscovered recoverable oil resources in the FSU range from 46 to 187 B/bls, with the most likely amount at 101 B/bls.[10] Because some of these resources are located in remote areas and/or hostile environments, future exploration and production will be technically more difficult and the costs will be higher.

About 90 percent of FSU's proven reserves (51.4 B/bls) are located in Russia. Western Siberia and the Volga-Urals have the largest fields. Kazakhstan and Turkmenistan together rank second with 3.3 B/bbls, most of which is located in the northwestern region of Kazakhstan near the Caspian Sea. The discovery of the Tengiz oil field may add another 5 B/bbls to Kazakhstan's oil reserves. However, development of the field has been hampered by inadequate chilling and production equipment, challenges presented by abnormally high downhole pressures, and the highly corrosive characteristics of the oil-field associated gas. Next in oil reserves is Azerbaijan with 1.2 B/bbls. Most of Azerbaijan's oil resources are offshore in the Caspian Sea. Other former republics have only small amounts of oil.11 Romania is the only former Soviet satellite country that has significant oil reserves.

Figure 3-1—1990 Oil Reserves—Selected Countries



SOURCE: Energy Information Administration, U.S. Department of Energy, Annual *Energy Review* 1991, DOHEIA-0384(91), June 1992, p. 267.

The FSU lacks the financial wherewithal and the technical expertise to develop these reserves. Several years ago, the Soviet Union opened its doors to foreign investment, and the international oil industry showed considerable interest in acquiring joint venture exploration and development rights. However, many joint venture negotiations have been and continue to be embroiled in political and legal difficulties. Uncertainties about who's in charge, export taxes, rate of return, currency stability, legal issues, and the economy in general have plagued U.S.-Russia negotiations.

In recent months, however, the outlook for Russian/American joint ventures looks a little brighter. Conoco, for example, recently started developing oil fields north of the Arctic Circle and west of the Ural Mountains. This joint venture, called Polar Lights, is the frost new-field

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10 Joseph P. Riva, Jr., *Russia and the Commonwealth of Independent States: Oil Resources*, CRS Report for Congress, *92-78* SPR, Jan. 16, 1992, pp. 2-4.

11 Joseph P. Riva, Jr., *Production and Reserves in the Soviet Republics*, CRS Report for Congress, *91-674* SPR, Sept. 12, 1991, p. 1.

development project in Russia to include a U.S. partner.[12] And in late October, Occidental Petroleum Corp. exported its first oil shipment from Western Siberia. Oxy's joint venture has a license to export 367,647 barrels of oil during the 4th Quarter 1992.[13] These few successes, however, belie the daunting uncertainties that still remain on taxes, royalties, etc. In particular, the introduction of an oil export tax ($5 to $6/barrel) in 1992 has altered project economics and delayed negotiations on a number of proposals. The White Knights Joint Venture Enterprise, for example, has put on hold its second project, Golden Mammoth. Moscow has waived the tariff for projects agreed on after January 1, 1992. Conoco's Polar Lights project has been exempted from the tax. It is likely that the export tax will remain in effect until energy prices reach world market prices.

The situation in Kazakhstan is different. Kazakhstan has made it clear that foreign investors are welcome. There is no confusion about who has authority to negotiate and sign deals. Moreover, oil industry taxes are light. Deals with Chevron, British Gas, Italy's Agip, and France's Elf should bring about $38 billion in foreign investment to Kazakhstan's oil industry over the next 40 years.[14]

PRODUCTION

The former Soviet Union was the world's largest producer of oil and natural gas and the second largest consumer. In 1990, the FSU produced 11.4 million barrels per day (MMB/D), primarily from Russia.[15] Much of Russia's oil production facilities are located in Western Siberia, particularly the Tymen Oblast. Kazakhstan and Azerbaijan are also major oil producers, ranking second and third. Kazakhstan produces about 500,000 barrels per day, and Azerbaijan, about 240,000 barrels per day.[16] (See table 3-1 for a breakdown of FSU production and consumption data.)

Table 3-I—Energy Production and Consumption, Selected Countries[a] (thousand barrels per day oil equivalent)

	Production				Consumption			
	011	Gas	Coal	Electricity	oil011	Gas	Coal	Electricity
Azerbaijan	244	140	—	38	215	279	2	33
Kazahkstan	502	110	1,164	141	450	175	583	153
Russia	10,328	9,956	3,503	1,744	4,982	7,417	3,155	1,518
Ukraine	100	451	1,463	492	1,111	1,804	1,316	411
Estonia	0	0	0	28	62	25	4	15
Latvia	0	0	0	9	111	48	5	15
Lithuania	0	0	0	40	173	86	10	24
Total FSU	11,394	12,665	6,235	2,784	8,400	11,078	5,245	2,424
Poland	3	63	2,232	6.5	324	183	1,871	9
Hungary	55	95	105	7	185	188	145	92
Czechoslovakia	3	13	836	136	306	184	827	143

[a] Source for FSU data is EIA, International Energy Outlook 1992, p.43 (1990 data); source for Poland, Hungary, and Czechoslovakia data is International Energy Agency (1989 data).

12 "Russian View of Ventures Brightens," *Oil and Gas Journal,* Aug. 3, 1992, vol. 90, No. 31, p. 20.

13 "R~sian Upstream Joint Ventures Logging Progress," *Oil and Gas Journal,* vol. 90, No. 44, Nov. *2, 1992,* p. 28.

14 "Tomorrow's Gusher," *The Economist,* vol. 324, No. 7769, July 25, 1992, p. 72.

15 Energy Information Administration, Department of *Energy, International Energy Outlook 1992,* DOE/EIA-0484(92), April 1992, p. 10.

16 Ibid, p. 43.

As noted earlier, the FSU experienced several downturns in oil production. Production stagnated from 1980 to 1983, then fell slightly in 1984 and more sharply in 1985. This slump was caused by policy decisions that favored short-term production goals at the expense of exploration and discovery. Exploration investment as a share of total oil and gas investment decreased steadily from 1971 to 1985. As a result, there was a decline in the number of exploratory wells completed and new deposits identified. At the same time, old fields output declined more sharply than expected. Soviet leaders stabilized the situation by increasing and shifting funding to new fields development drilling in Western Siberia.[17]

Production recovered in 1986 and continued to grow until mid-1988, peaking at nearly 12 MMB/D. Since then, oil output has been on a downward slide. In 1991, production declined to 9.8 MMB/D, with Western Siberia reporting the greatest losses.[18] In the Tyumen area, a third of all oil wells are idle.[19] Production in 1992 production declined even further to about 7.85 MMB/D.[20] The initial cause stemmed from a failure to improve productivity. The use of outmoded technology, overreliance on waterflooding recovery techniques, and poor maintenance and repair were largely responsible. Inadequate exploration also played a role. The dissolution of the Soviet Union and the resultant economic and political changes are central to the continued decline.[21]

EXPORTS

The majority of FSU oil exports are destined for European countries. Oil is transported to Eastern Europe via pipelines and to Western Europe by tankers. In 1988, East European countries received about 40 percent of total oil exports from the FSU. About one-half went to Western Europe, which earned the FSU about $10 billion in hard currency. In 1990, the FSU reduced oil supplies to Eastern European Countries to about 36% of total oil exports. The region is attempting to diversify its oil supplies to include those from the Middle East and North Afica.[22]

Natural Gas

RESERVES

The FSU has 40 percent of the world's natural gas reserves-about 1,750 trillion cubic feet (tcf). In comparison, the U.S. share of world natural gas reserves is 175 tcf, or 4 percent of the total.[23] (See figure 3-2.)

Between 80 and 90 percent of the FSU's reserves are located in Russia. The largest fields are found in the Tyumen Oblast of Western Siberia. In addition, vast amounts of natural gas are thought to lie beneath the Arctic Ocean. Turkmenistan also has significant natural gas reserves located along its border with Iran.[24] Ukraine's natural gas deposits are either depleted or uneconomical to explore and produce.

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17 Thane Gustafson, *Crisis Amid Plenty* (Princeton: Princeton University Press, 1989).

18 Energy Information Administration, Department of Energy, *Annual Energy Review 1991*, *DOE/EIA-0384(91)*, June 1992, p. 259.

19 "The Soviet Energy Industry POWERLESS," *The Economist*, vol. 319, No. 7702, Apr. 13, 1991, p. 68.

20 "Former Communist Bloc Oil Production Shows Record Slide for 1992," *Oil and Gas Journal*, vol. 91, No. 10, Mar. 8, 1993, p. 17.

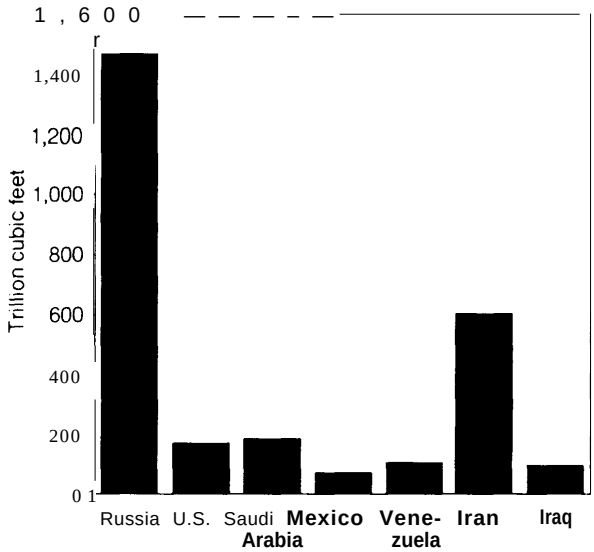
21 Ibid.

22 Central Intelligence Agency, *Soviet Energy Data Resource Handbook*, supra note 2, p. 19; and *International Energy Outlook 1992*, supra note 15, p. 36.

23 EIA, International Energy Outlook 1992, supra note 15, p. vii.

24 Ibid, p. 42.

Figure 3-2-1990 Gas Reserves—Selected Countries



SOURCE: Energy Information Administration, U.S. Department of Energy, *Annua/ Energy Review 1991, DOE/EIA-0384(91),* June 1992, p. 267.

Poland has proven natural gas reserves as well. One source estimates proven reserves at 12 tcf. However, much of its highly dispersed reserves, which have low Btu (British thermal unit) value, remain untapped because of a shortage of financial resources to explore and develop them.[25]

PRODUCTION

The FSU is the largest natural gas producer and consumer in the world. In 1990, natural gas production totaled 29 tcf, with about 79 percent (23 tcf) coming from Russia. Russia's production facilities are situated in Western Siberia, particularly in the Urengoi and Yamburg fields. Turkmenistan, the second largest gas producer in the FSU, produced about 3.1 tcf of gas or nearly 11 percent of the 1990 tota1.[26]

Unlike the oil industry, the natural gas industry has maintained fairly stable production levels, despite the political turmoil. In 1992, for example, Russia produced about 22.6 tcf. The natural gas industry is relatively young and requires less sophisticated technologies than does the oil industry. Thus, the industry may not require large amounts of capital to maintain present production levels. Transport of gas to markets could be a greater problem than production. Many pipelines and compressors are deteriorating and in need of repair. Losses of gas from leaky transmission and distribution lines are a serious problem.

In world energy markets, natural gas is expected to provide an increasing share between now and 2010. The abundance of the resource, technological advances in gas-fired equipment and processes, environmental problems associated with other fossil fuels, particularly coal, nuclear safety concerns, and costs, all contribute to enhancing the future prospects for natural gas production and use.

Increases in natural gas production in Russia are possible. However, many problems and concerns need to be addressed. Much of the increase would have to come from new fields located in remote and difficult production areas, requiring huge investment. Transportation is also problematic. Increased production will require the construction of extensive new pipelines. At a time when financial resources are scarce, the money needed to maintain and/or increase gas production may not be there.

EXPORTS

The Soviet Union exports considerable amounts of natural gas. In 1990, for example, the U.S.S.R. provided about one-third of all internationally traded natural gas,[27] much of it to Europe. Russia and Turkmenistan are expected to continue to be major exporters for the near future. In recent months, Central and Eastern European countries

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2S U.S. Agency for International Development, Office of Energy, *Poland:* An Energy *and Environmental* Overview, prepared by Argonne National Laboratory, October 1990, p. 19.

26 EIA, *International* Energy *Outlook 1992,* supra note 15, pp. 41-43.

27 Ibid, p. 35.

has shown interest in importing gas from other countries, such as Algeria and Norway, to reduce their dependence on FSU exports. Concerns about Ukrainian/Russian tensions have forced Eastern European customers to look elsewhere for gas supplies. Russia's major natural gas export pipelines pass through Ukraine, now an independent country. On a number of occasions, Ukraine has threatened closure of the gas pipelines that cross its territory.

Ukraine itself is very dependent on Russia for much of its natural gas supplies. In recent months, the liberalization of fuel prices has created tensions between the two countries, which resulted in Ukraine briefly shutting down gas pipelines to Western Europe. Ukraine is now trying to build closer ties with Iran, partly to diversify energy sources. In April 1992, Iran agreed to supply Ukraine 4 to 5 million tons of oil and 25 billion cubic meters of gas this year. Also, Ukraine and Iran agreed to build gas pipelines from Iran to Western Europe through Ukraine.[28]

Coal

RESERVES

The FSU has huge coal reserves, estimated at 263 million short tons. Together, the FSU, United States, and China account for two-thirds of total world reserves.[29] Immense reserves are scattered throughout the FSU. Ukraine's Donets Basin, located in the southern part of the country, is the largest coal producing region in the FSU, and a valuable source of coking coal.[30] In Kazakhstan, the northeastern Basin near western Siberia yields substantial coal resources. Also, substantial reserves are located in Western and Southern Siberia.

Table 3-2—Coal Reserves and Production, Selected Countries (million short tons)

Country	Recoverable reserves[a]	Production[b]	Consumption
U. S. S. R.	263,470	694	661
Poland	43,728	289	253
Czechoslovakia	5,91 8'	118	119
Hungary	4,91 6'	NA	NA
United States	265,173	1,029	896
Total World	1,167,346	5,211	5,171

a source for reserves data is British Petroleum Statistical Review of World Energy, June 1991 (1990 data).
b includes anthracite, bituminous, lignite, and brown coal.
c source for Czechoslovakia and Hungary reserves data is World Energy Council Survey of Energy Resources (1987 data).

SOURCE: Energy Information Administration, *Anual Energy Review 7997*, June 1992, pp. 291, 293, and 297.

Poland's recoverable reserves are estimated at about 44 billion short tons.[31] Its substantial hard coal reserves are found primarily in the Upper Silesian Basin in the South. Lignite reserves are scattered throughout central and western Poland. The former CSFR (mainly the Czech Republic) and Hungary also have coal reserves, but far less significant than the FSU and Poland. Lignite is prevalent. (See table 3-2.)

PRODUCTION

Over the last few years, coal production has been declining. In 1989, the FSU produced 761 million short tons (MST), which declined to 694 in 1990.[32] Labor unrest contributed signficantly to declining output. Unlike the oil and gas industries, coal industry output is closely linked to social issues. Low morale and salaries and wretched working and living conditions led to miners' strikes in the FSU in 1989, 1990, and 1991.

28 Steven Woehrel, *Ukraine,* CRS Issue Brief, IB92072, July 24, 1992, p. CRS-9.

29 EIA, *Annual Energy Review 1991,* supra note 18, p. 261.

30 EIA, *International Energy Outlook 1992,* supra note 15, p. 37.

31 *Annual Energy Review 1991,* supra note 18, p. 291.

32 Ibid, p. 293.

Table 3-3—Nuclear Power Reactor Statistics (August 1992)

Country	Operable Units	Operable MWe	Under construction Units	Under construction MWe	Planned Units	Planned MWe	Nuclear generation in 1991 TWh	Nuclear generation in 1991 % of total
Bulgaria	6	3,760	0	0	0	0	13.2	34.0
CSFR	8	3,488	6	3,788	2	2,028	23.8	28.6
Hungary	4	1,810	0	0	2	2,000	13.7	46.1
FSU	56	36,899					210	8.1
Kazakhstan	1	150	0	0			NA	NA
Lithuania	2	3,000	0	0		0*	NA	NA
Russia	39	20,941	9	6,600	4*	4,000"	NA	NA
Ukraine	14	12,808	3	3,000	0*	0*	NA	NA
Total	74	45,957	18	13,388	•	•		

•Plans very uncertain.
NA = not available

SOURCE: Nuclear Engineering *International, World Nuclear Industry Handbook 1993,* pp. 10 and 14.

Poland is a major coal producer, ranking fifth in the world. In 1990, Poland produced 289 MST. Also, the former CSFR is a major coal producer; however, its output has declined in recent years from 130 MST in 1989 to 118 MST in 1990.[33]

EXPORTS

Despite the decline in production, the FSU and Poland remain major coal exporters. In 1989, the FSU and Poland supplied 8 percent and 7 percent respectively of the world's total exports, most of which went to Europe.[34]

The outlook for the coal industry is uncertain. The coal industry is in need of extensive modernization. The use of old, inefficient technologies is commonplace, resulting in low yields. In addition, production costs are escalating rapidly and transportation costs are high, when compared to natural gas. Some restructuring of the coal industry in Hungary, the former CSFR and Poland has already begun. In Hungary, for example, several coal mines have been closed, prices raised, and subsidies canceled; Czech coal production is being reduced by 40 percent.[35]

Associated environmental problems further cloud the outlook. The burning of low-quality lignite (brown coal) is largely responsible for the alarming degradation of the environment in CEE. Poland is taking steps to retrofit power-plants to burn coal more efficiently and cleanly. Technological advancements in clean coal-burning technologies and pollution control equipment could stimulate coal production.

Nuclear

As of August 1992, there were 74 operating nuclear power reactors in Central and Eastern Europe and the former Soviet Union. (See table 3-3 for a breakdown of the number of plants and capacity, by country.) Ukraine has a heavy concentration with fourteen.[36]

About 35 percent of these reactors are the older Soviet-designed units-the RBMK (Chernobyl-type) and VVER/440-230 models.[37] The VVER is a pressurized light-water-cooled reactor. The

33 Ibid.

34 EIA, International Energy *Outlook 1992,* supra note 15, p. 37.

35 "A New Role for Nuclear Energy ?,' *The OECD Observer, No, 170,* June/July 1991, p. 20.

36 Nuclear Engineering International, *World Nuclear Industry Handbook 1993* (Sutton, England: Nuclear Engineering International, 1993), p. 10.

37 Ibid.

RBMK is a light-water-cooled, graphite moderated pressure-tube power reactor that is unique to the FSU.

Concerns about the safety of the RBMK and older VVER/400 models has prompted some anti-nuclear sentiment in this region. The RBMK and older VVER/440 models elicit the most concerns. The RBMKs have serious problems with electrical systems instrumentation and fire protection, and- they lack western-style containment structures. The Ukrainian Parliament voted to shut down the RBMK reactor at Chernobyl in 1993 and placed a moratorium on new construction. Some VVER/440-230 models lack emergency cooling systems and protective structures to contain radioactive materials. Expensive improvements are needed to make them safer.

In the interest of safety, a number of organizations and individuals believe that the RBMKs should be shut down. The European Community is particularly concerned about the condition of these aging plants and has offered financial assistance to correct problems. In addition, the G-7 countries have recently agreed to create a fund to improve the safety of reactors in the FSU and Eastern Europe. The European Bank for Reconstruction and Development will manage the fund. France and Germany together pledged $80 million; the United States has not yet committed to a specific funding amount. The first country recipients will be Bulgaria and Slovakia. Ukraine and Russia are also slated to receive funds.[38]

Despite safety concerns, some countries are reluctant to shut down nuclear plants. The need for power supplies to fuel economic growth and the desire to reduce consumption of polluting fossil fuels are two major reasons these plants continue to operate. Many of these countries have energy supply deficits, and nuclear energy would help fill the gap. However, the independence that nuclear may provide is tempered by the fact that most CEE countries are dependent on Russia for nuclear fuel supplies and fuel management.

Hungary depends on nuclear power for about half of its electricity needs. The former CSFR derived about 28 percent of its electricity from nuclear sources.[39] In addition, it has one of the biggest nuclear industries in Eastern Europe. It is the only non-FSU country to build and export Soviet-designed nuclear reactors. Also, Ukraine and Lithuania are heavily dependent on nuclear power. For the time being, there are no nuclear power plants in Poland. However, nuclear power may contribute to Poland's electricity capacity after the year 2005. One source estimates that nuclear power can contribute up to 34 Terawatthours/year.[40]

OUTLOOK

The prospects for nuclear power development in Central and Eastern Europe are uncertain. After the Chernobyl accident, concerns about nuclear safety heightened, mistrust of Soviet technology and expertise grew, and construction slowed. Nuclear power development programs were scrutinized and re-evaluated to determine whether plants should be modernized or decommissioned or plans scraped. In the FSU, for instance, about 106,000 megawatts (MW) of planned nuclear capacity were deleted from energy plans after the Chernobyl accident.[41] It now appears that the moratorium on nuclear powerplant construction in Russia has been lifted. Recently, the Russian government approved an ambitious nuclear program that would add at least 30 new nuclear powerplants and double Russia's nuclear energy capacity by 2010. This decision reflects the government's need to export oil and gas for badly

38 Marlise Simons, "Major Powers Back a Fund for Soviet-Design Reactors," *The New York Times International,* Jan. 29, 1993, p. A2.

39 Ibid, p. 10.

40 Personal communication, Slawomir Pasierb, The Polish Foundation for Energy Efficiency, Jan. 4, 1993.

41 Robert reel, SAIS Conference on World Oil in the 1990s—Soviet Union and Eastern Europe, Washington, D. C., Nov. 3, 1991.

needed hard currency and a resurgence of the atomic energy industry .42

Many difficulties lie ahead. The financial costs of upgrading and/or decommissioning enormous, overcoming public opposition will be challenging, and the need for Western expertise and technology is sizable. Many Western companies are courting Eastern European countries for orders to modernize or construct new plants. In the meantime, the industry must manage and operate its nuclear enterprises safely and economically to regain public confidence. With the decline of cheap Soviet energy exports and environmental concerns about the use of highly polluting coal, some countries may feel they have no choice but to pursue nuclear power.

| Renewable

In Central and Eastern Europe, renewable energy sources contribute only a small share of total production. Hydroelectric power is the most developed renewable resource. In 1990, the FSU had 64.6 gigawatts of hydro capacity, which is about 19 percent of total installed capacity.[43]

Biomass fuels may be a signnificant energy resource in rural areas. Consumption is difficult to measure because so much of it never enters the commercial market. Wood, for example, is gathered by individuals and families as the need arises.

Wind and solar energy hold promise for the future, particularly in rural areas. Their roles could expand substantially as their production costs decline. Moreover, the need to diversify energy supplies may spur the development of indigenous renewable energy resources. Several U.S. companies, such as Integrated Power, are interested in marketing wind and photovoltaics to the FSU.

OVERVIEW OF ENERGY DEMAND

The FSU is the world's largest consumer of natural gas, the second largest consumer of petroleum, and is second only to the United States in total energy consumption. From 1974 to 1988, both the FSU and Eastern Europe experienced higher growth rates in energy consumption than the Organization for Economic Cooperation and Development (OECD) countries.[44] As mentioned earlier, energy intensity is also high compared to the United States, Japan, and Western Europe.

The emphasis on heavy industries and energy production and transmission losses have contributed substantially to the high energy requirements in this region. Major energy production facilities often are located in remote areas, particularly Siberia, far from major consumers. In the FS, oil and gas transport distances have increased dramatically. During the 1975-85 period, the average distance gas was transported doubled to 2,000 kilometers. The greatest natural gas losses occur during transmission. Decrepit pipelines and inefficient compressors are largely responsible for this situation. Moreover, natural gas production losses are high. About 30 percent of associated gas is flared because there is a shortage of gas processing equipment for oil-field associated **gas.**[45]

The other former republics vary in their patterns of energy use. Ukraine, for example, has one of the largest coal-producing regions in Eastern Europe--the Donets Basin, and thus relies extensively on coal. Poland, also relies on coal for **a** large percentage of its energy needs. This reliance is unlikely to diminish before the end of the

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42 Fred Hiatt, "Ftussia Plans To Build More Reactors, " *Washington Post,* Jan. 13, 1993, p. A19.

43 EIA, *Annual* Energy *Review 1991*, supra note 18, p. 299.

44 A Report to the U.S. Working Group on Global Energy Efficiency, *Energy Efficiency, Developing Nations, and Eastern Europe,* June 1991, p. 2.

45 Lee Schipper and R.C. Cooper, Lawrence Berkeley Laboratory, *Energy Use and Conservation in the U.S.S.R.: patterns, prospects, and Problems, LBL-29830,* April 1991, pp. 8-9.

Table 34-1989 Sectoral Final Energy Use, Selected Countries

Sector	FSU		Poland		CSFR		Hungary		US.	
	Petajoules	%	Petajoules	%	Petajoules		Petajoules	%	Petajoules	%
industry	18,619	49	421	40	1,064	49	358	40	17,518	31
Transport	6,180	16	135	13	168	8	119	13	20,470	37
Residential/Commercial	9,488	25	446	42	665	30	336	37	17,233	31
Agriculture	3,853	10	45	4	144	7	56	6	656	1
Other	2441	1	—	—	140	6	34	4	173	—
Total	38,385	100	1,046	100	2,181	100	903	100	56,051	100

SOURCE: OTA estimates based on IEA, ***Energy*** *Statistics* and Balances ***of Non-OECD Countries 1988-198% Energy*** *Balances of* ***OECD Countries 1989- 1990 Energy Balances or OECDCountries 1987- 1988;*** and World Bank, ***Greenhouse Gas Strategy for Eastern Europe and the FSU,*** August 1992.

century. Hungary's energy use is diversified compared to other Eastern European countries and its energy intensity is the lowest in the region. However, Hungary is still a very energy-intensive nation because of its emphasis on heavy industry and its low productivity levels. Hungary imports about half of the energy it uses. In the former CSFR coal and lignite comprise a significant percentage of total primary energy use, accounting for almost 60 percent. Much of the coal is of poor quality, and its use has resulted in significant environmental degradation.

There is a huge potential for improving energy efficiency in Central and Eastern Europe. In fact, this potential may be the greatest in the world. However, there has been little experience in exploiting this potential to date, Identification of the most promising energy-saving technologies, projects, and policies has just begun. The lack of or uncertainty about energy-use data is just one of several stumbling blocks to developing rational energy efficiency policies. The following section briefly describes energy use in the various sectors of the economy (see table 3-4) and barriers to using energy more efficiently. Chapter 4 provides a more indepth discussion of the energy savings potential in Central and Eastern Europe.

| Residential/Commercial Sector Demand

Data on existing FSU building stock are uncertain, and residential/commercial sector energy use data are scarce. This is particularly true for housing in rural areas, where individuals or families directly obtain fuels, such as wood, for much of their energy needs. Despite the uncertainty and availability of the data, some observations can be made about residential/commercial sector energy use.

Residential and commercial energy use accounts for about 25 percent of total energy demand in the FSU. (See figure 3-3.) Space heating dominates sector demand. Sources include district heat, direct fuel use (for heating and cooking stoves), and electricity.

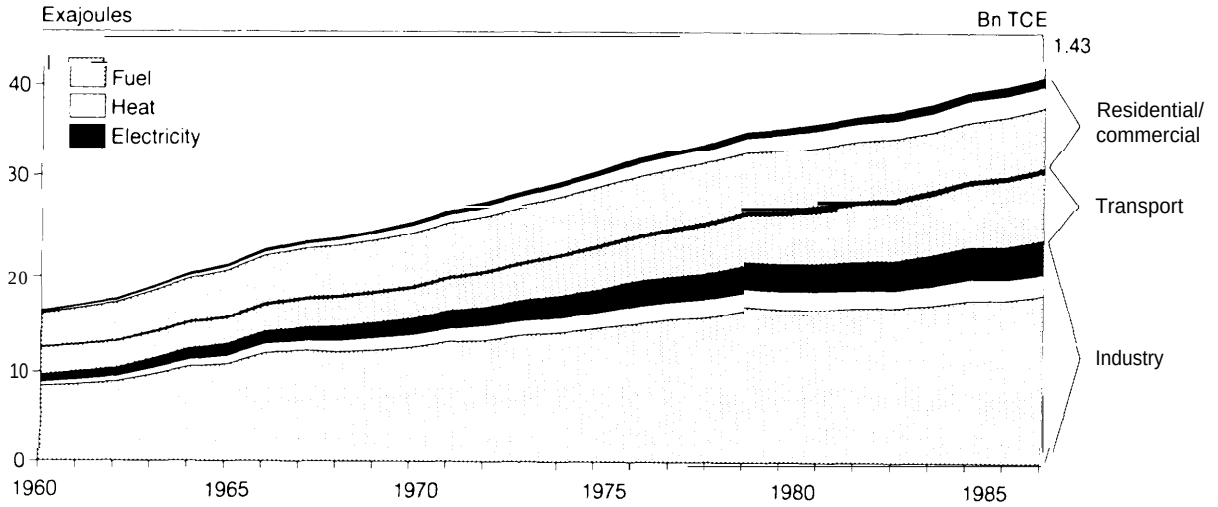
District heating[46] is used primarily in urban areas. Its feasibility is dependent on the size and location of the city. In rural areas, fuel usually is used directly. Natural gas, kerosene, wood, and coal are the most frequently used fuels. According to Lawrence Berkeley Laboratory (LBL), in 1985 about one-quarter of rural families in the FSU used coal or wood for heating, 59 percent used natural gas, 9 percent used LPG, and 1 percent used heavy oil.[47]

Electricity use per capita and/or per household is quite low in the former Soviet Union. In 1987, homes and buildings accounted for only 9 percent

46 Heat (in the form of hot water or steam) is produced at a central plant and distributed directly to buildings through underground pipes.

47 Schipper and Cooper, supra note 45, p. 21.

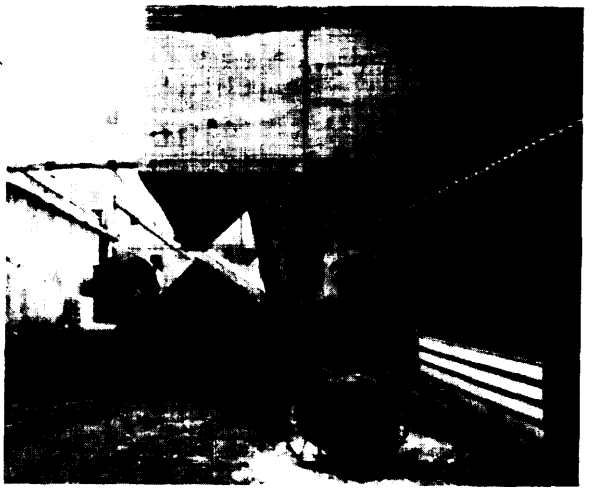
Figure 3-3—Energy Use in the U.S.S.R. Sectoral Breakdown of Energy Forms



NOTE: Electricity, heat counted at end-use values.

SOURCE: R. Caron Cooper and Lee Schipper, "The Efficiencyof Energy Use in the USSR—An International Perspective," ***Energy, Theternatiorra/ Journal,*** vol. 17, ***No. 1,*** 1992; "The Soviet Energy Conservation Dilemma, *Energy, Policy, vol.19,* ***No. 4,*** **May** 1991; Lee Schipper and Steve Meyers et al, ***Energy Efficiency*** **and** ***Human Activity: Recent Trends, Futilee Prospects*** (Cambridge University Press, 1992).

Larry Markel



Coal ash pile behind apartment house in Kracow, Poland. This building is being modernized as apart of an AID demonstration project.

of electricity use, compared to 25 percent in the United States and 20 percent in Western Europe. [48]In the FSU, electricity is primarily used for lighting and motors. Air conditioning is not widely used in this region but is becoming more popular in commercial buildings, particularly in Southern areas. Its growth will contribute substantially to increasing electricity use in the buildings sector in the future. (See figure 3-4 for home electricity use in the U.S.S.R. and other countries.)

The energy intensity of buildings is quite high. Windows are not sealed properly, insulation is poor, and there are few thermostats or controls to regulate temperature. Moveover, typical appliances and lights are extremely inefficient.

In Poland, the buildings sector is the leading energy user but only by a small margin. It accounts for about 42 percent of final energy demand. More than half of this sector's energy is derived from coal and lignite. Coal is used primarily in homes to produce hot water and heat. Natural gas and oil provide more than 25 percent

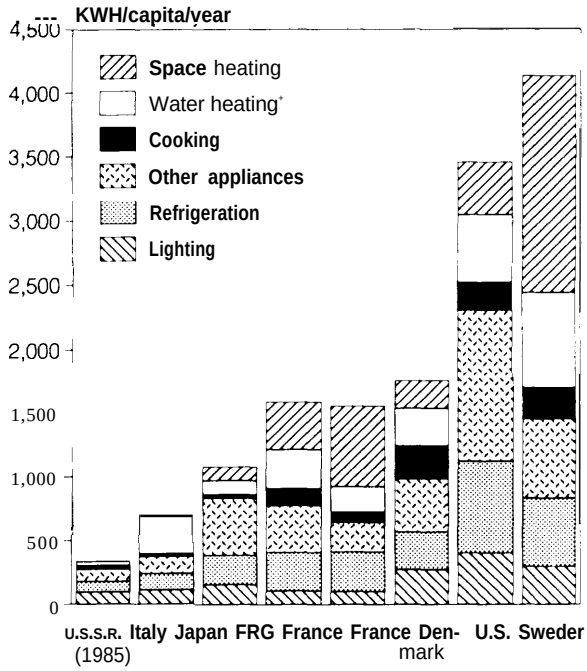
48 Ibid, pp. 19-21.

of sector energy; and electricity, 8 percent. The buildings sector accounts for about a 45 percent share of total electricity use.[49]

The residential/commercial sectors in Hungary use district heating and coal extensively. Household electricity use is low compared to western industrialized countries. However, residendential/ commercial electricity use has been growing since the 1980s. The increases in electricity demand were spurred by service industry growth. This growth reflects a shift away from heavy industry and materials production.[50]

Common inefficiencies found throughout Central and Eastern Europe include lack of insulation in roofs and walls, energy-inefficient lighting, poor quality motors and appliances, inadequate construction and high infiltration. Low-cost/no-cost measures can provide significant energy savings. A few examples are thermostats to regulate heat, properly sealing windows, and providing adequate roof insulation. Behavioral changes are another important factor in achieving energy savings in this sector. Chapter 4 provides a detailed discussion of the technical potential for saving energy in the buildings sector.

Figure 34-Home Electricity Use in 1986 U.S.S.R. and OECD Countires



• Water heating includes washers

SOURCE: R. Caron Cooper and Lee Schipper, "The Efficiency of Energy Use in the USSR-An International Perspective," Energy, ***The Internationd Journal, vol. 17, No. 1,*** 1992; "The Soviet Energy Conservation Dilemma," Energy ***Policy,*** vol. 19, No. 4, May 1991; Lee Schipper, Steve Meyers et al, ***Energy Efficiency and Human Activity: Recent Trends, Futile Prospects*** (Cambridge University Press, 1992); and Lee Schipper and Dianne V. Hawk, "More Efficient Household Electricity Use: An International Perspective," ***Energy Policy,*** vol. 19, No. 3, April 1991.

| Industry

In most Central and Eastern European countries (Poland is the exception), industry commands the largest share of the energy pie. Cheap and abundant energy sources fueled the tremendous growth in the industrial sector, particularly of energy-intensive heavy industries, over the last 40 years. Some of the high-output industries include iron and steel, chemicals, cement, and fertilizers. The FSU, for example, is the world's largest steel producer. It produces 50 percent more than Japan.[51] In Ukraine, Coal mining and ferrous metallurgy are the dominant industries. In 1990, these two industrial sectors accounted for 40 percent of industrial assets and 20 percent of output in Ukraine .52 Throughout the region, finished goods production, such as autos, appli**ances,** clothing, etc. was very low.

Many industries are very energy intensive. They require more than twice the energy per unit of output than do similar activities in Western

49 U.S. AID, *Poland: An Energy and Environmental Overview,* supra note 25, p. 39.

50 International Energy Agency, *Energy Policies: Hungary, 1991 Survey,* 1992, pp. 26, 84-85.

51 Schipper and Cooper, supra note 45, p. 13.

52 Steven Woehrel, Ukraine, supra note 28, p. crs-7.

industrialized nations.[53] The most energy intensive industries are iron and steel, chemicals, cement, and petroleum refining. Because industrial production contributes a large share of GNP, industrial energy use greatly contributes to the overall high-energy intensities of these countries' economies. Thus, much attention has been focused on this sector to reduce energy demand.

In the industrial sector, structural changes are likely to make a big difference in energy use. Moving away from heavy industry to less energy-intensive consumer products will do much to reduce energy use. Diminishing the role of the iron and steel industry in the economy is key to structural change. This can be accomplished by reducing metals use, either absolutely or by substituting other lighter-weight materials and by better matching production with demand, rather than planned targets. The metal intensity of Eastern European goods is higher than comparable products in the West. One estimate indicated that equipment in the FSU is 10 to 70 percent heavier.[54]

Another way to reduce energy use is to upgrade technologies and processes. The steel industry in the FSU, for example, relies heavily on old technologies, e.g., the open-hearth furnace, that are inefficient. Continuous casting, which can provide significant energy savings, is used in only 17 percent of FSU castings, compared to 53 percent in the United States and 90 percent in Japan. Substantial energy savings can be realized in other industries as well. The dry process method of cement production uses 20 to 30 percent less energy than the wet process. In the FSU, only about 15 percent of cement is produced using the dry process.[55]

It is important to note that none of these measures is likely to succeed unless economic reforms, especially of the pricing system, are supported. The effectiveness of these reforms will largely determine the potential to save energy. See chapter 4 for a discussion of industrial sector energy savings potential.

Transportation

Transportation plays an important role in the economy of the FSU. The size and diversity of its resources and population require an extensive transport network.

Freight accounts for the largest share of total transport sector energy use. Long distance rail and pipeline dominate. (See figure 3-5.) In the FSU, freight intensity is very high--28,000 tons-kilometer/capita.[56] Since the 1960s, shipping distances have increased steadily. Transport of energy, particularly coal and oil from Western Siberia, is largely responsible for the increase in freight activity.

Poland's extensive railway system played a major role in moving freight between the FSU and Western Europe and between Czechoslovakia and Polish ports. In 1985, nearly 1 billion tons were hauled by freight, compared to 289 million tons in Czechoslovakia, and 127 million tons in Hungary .57

Truck use is slowly rising in this region. The use of diesels has improved truck fuel economy but not to the level of Western European countries.

Passenger mobility is very low compared to Western countries. Bus is the most frequently used mode of passenger travel, followed by rail. There are few private automobiles in Central and Eastern Europe--about 50 per 1,000 people in the FSU, compared to about 600 in the United States. Among its neighbors, Poland has the lowest ratio

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53 A Report to the U.S. Working Group on Global Energy Efficiency, supra note 44, p. 3.

54 Schipper and Cooper, supra note 45, p. 26.

55 Ibid, p. 28.

56 Ibid, figure 16, p. 53.

57 U.S. AID, *Poland: An Energy and Environmental Overview*, supra note 25, October 1990, p. 45.

(about 127 cars per 1,000 people) .58 In recent years, travel by private auto has been rising and probably will continue to rise. This is particularly true in urban areas.

The efficiency of automobiles is low. LBL estimated average automobile fuel consumption to be about 12 liters/100 km or 20 miles per gallon (mpg) in 1985, which is high by European standards. In the United States, automobile fuel economy averaged about 27.5 mpg in 1985. Some of the factors besides poor design that impact fuel economy include poor maintenance and fuel quality, traffic congestion, and cold weather conditions .59

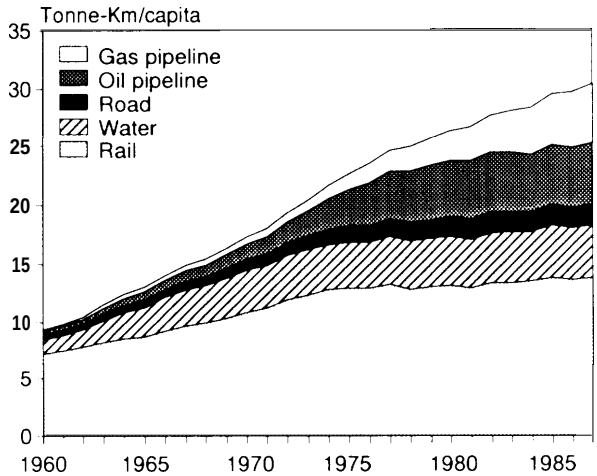
The energy intensity of passenger air travel is comparable to that in the United States. The primary reason is that Soviet-designed aircraft are packed with passengers. According to LBL, they have an average load factor of 97 percent.[60] However, the aircraft are inefficient if measured in energy use per seat/km. While the efficiency of U.S. aircraft improved significantly over the last two decades, no improvements in aircraft efficiency were noted in the FSU.

In this sector, fuel use has changed over the years. For rail transport, electricity and diesel have replaced coal and residual oil. Diesel is slowly replacing gasoline use in trucks and buses. For pipeline transport, gas provides more than one-third of the end-use energy; electricity, 5 percent; and liquid fuels about 60 percent.[61]

There is huge potential for growth in this sector, particularly personal travel. However, there is also significant potential for improving efficiency as well. Improvements in auto design and technologies, traffic control, and increased use of computers will do much to increase automobile fuel economy.

Structural changes in the economy, i.e., a shift away from heavy industry, will likely decrease freight activity. But a rise in demand for finished goods may increase truck transport. Also, higher quality, longer lived products will reduce waste. These and other topics are discussed in chapter 4.

Figure 3-5-Freight Movements in the U.S.S.R. by Major Mode



SOURCE: R. Caron Cooper and Lee Schipper, "The Efficiency of Energy Use in the USSR—An International Perspective," ***Energy, The International Journal, vol. 17, No. 1,*** 1992; "The Soviet Energy Conservation Dilemma," ***Energy Policy,*** vol. 19, No. 4, May 1991; and Lee Schipper, Steve Meyers et al, ***Energy Efficiency and Human Activity: Recent Trends, Futile*** Prospects (Cambridge University Press, 1992).

REASONS FOR INEFFICIENCY

Energy efficiency can save dollars and reduce environmental impacts associated with energy production and use. Yet, many opportunities to improve energy efficiency have not been tapped. There are a number of reasons why this is the case. One of the primary barriers to using energy more efficiently is the pricing system.

In the U. S. S. R., internal oil prices were set by the central government and were neither based on the cost of production nor tied directly to highly volatile world market prices. Rather, they were

58 Ibid, p. 42.

59 Schipper and Cooper, supra note 45, p. 19.

60 Ibid.

61 Ibid, p. 17.

Paul Komo



Integrated steel plant near Katowice, Poland. Up until recently, one of the its largest customers was the Soviet Army.

tied to past world market prices. Oil prices, for example, were based on a rolling average of world prices over the previous 5 years, later changed to 3 years. This pricing system, called the Bucharest Formula, helped to isolate the former Soviet Union and its Eastern European customers from the oil price shocks of the mid 1970s and early 1980s, while allowing gradual price increases or declines.[62]

In recent years, as costs of fuel extraction and power generation increased, actual energy costs moved further away from prices. When transportation and distribution costs are taken into account, energy prices become even more distorted.

In the residential sector, heat, hot water, and gas are not metered. The consumer pays a charge based on apartment size. Electricity use is metered, and payments are determined by the consumer who reads the meter and sends in the payment. These practices provide little or no incentive to use energy more efficiently.

The predominance of energy-intensive heavy industries in the economy also hampered efficiency gains. Historically, the Soviets emphasized large-scale, heavy industries, like iron and steel. The availability of enormous oil and coal resources near major urban centers fueled the development of the industrial sector. In addition the use of "value of output" targets encouraged the production of metal-intensive goods because they have a higher value. Soviet data suggests that the economy uses twice as much metal as the United States per unit of national income.

Yet another impediment to energy saving improvements is the use of old and obsolete technologies. In the FSU, technologies in basic industries have changed slowly. There were no incentives to develop new, more efficient technologies prices were low and energy abundant. Limited capital resources further constrained technology replacement rates, which were already low.

The lack of access to foreign technologies and expertise also may have been a limiting factor in pursuing conservation strategies. Even today, simple technologies that offer significant energy savings are not available in Central and Eastern Europe.

Management also hampered the efficient use of energy. Factory managers were concerned with meeting planned production targets at all costs. Little or no attention was given to energy use. Managers who met or exceeded production targets received bonuses; those who saved energy could be penalized by having their allocation reduced. In order to avoid being penalized, managers overestimated raw materials requirements, which contributed to the high metal energy intensities of CEE economies.

Today, managers are most concerned about keeping the business/plant open and workers employed. In the FSU, profits are given little consideration because taxes are so high (50 percent), and inflation (about 25 to 30 percent/ month) quickly makes any profit worthless.

The lack of consistent and reliable information on energy use has been cited as another impediment to energy efficiency. Data collection is

62 Shell Briefing Service, *Energy in the Soviet Union and Eastern Europe*, No. 2, 1991, p. 1.

uneven and uncertain. Reporting is often dispersed among various reports and publications. In many cases, basic data on energy consumption are missing. According to LBL, few Soviet publications analyze energy-intensity indicators, such as energy use per kilometer for autos, per square meter for space heating, etc. In addition, it is not clear whether data refer to actual energy use or how the fuel was allocated. Moreover, little information is available on the link between the relationship of structural changes in the economy to energy use. Structural changes include shifts toward less energy-intensive industries such as services, technology advances in production processes, and changes in consumer spending patterns. There is no doubt that ignorance about energy savings has limited investments in energy efficiency.

LINK TO ECONOMY AND ENVIRONMENT

Energy efficiency and conservation strategies must be considered within the context of the economic transition that is underway in this region. How the governments manage the transition will play a major role in determining the importance of energy efficiency in the economy.

Clearly, the governments are moving toward market-oriented economies, some more rapidly than others. However, social considerations, such as unemployment and providing for basic needs, constrain the pace. The scarcity of capital also constrains the pace of the transition in general and investment in energy efficient technologies and measures in particular. What little capital is available is used to increase production. Investments that reduce expenses only, such as many energy efficiency measures, are given lower priority. (This can be true in Western countries as well.)

Nevertheless, changes in energy use will have an effect on CEE economies. Reductions in energy demand could free up capital required for energy development and cut expenses in every sector. Also, oil saved can be exported to generate badly needed hard currency and ease pressure on world markets. Energy efficient technologies also can improve productivity, which in turn can spur economic growth.

Energy efficiency measures offer environmental benefits as well. High energy intensity coupled with the low priority given to environmental considerations have left Central and Eastern Europe with serious air and water degradation. The transboundary nature of air pollution has heightened Western European concerns and underscored the importance of CEE fuel use on an international level. Moreover, this region is a major contributor to greenhouse gases. In 1985, the FSU and Central Europe accounted for about 22 percent of global greenhouse emissions.[63] The United States is also a leading contributor of greenhouse gases, accounting for about 20 percent of the world's warming commitment. Improvements in energy efficiency could reduce global greenhouse gas emissions and other pollutants that have more regional and local effects.

Cleaning up pollution will require many years of effort and large infusions of capital. The Polish Government, for example, estimates that $260 billion will be needed to attain European Community (EC) environmental standards and reach reach sustaninable economic de velopment. [64] The same is largely true for other countries in the region. A United Nations report estimates that capital requirements on the order of about $1,200 billion over the next 2 to 3 decades are needed to modernize the energy sector and introduce acceptable environmental standards in this region.[65]

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63 Office of Technology *Assessment Changing By Degrees. Steps to Reduce Greenhouse Gases,* OTA-O-482 (Washington, D.C.: U.S. Government Printing Office, February 1991), p. 5.

64 Stanley J. Kabala, "The Environmental Morass in Eastern Europe," *Current History*, vol. 90, No. 558, November 1991, p. 388.

65 United Nations, Energy *Reforms in Central and Eastern Europe-the First Year,* supra note 1.

Many measures can improve air and water quality and reduce greenhouse gas emissions. Energy efficiency improvements may be the most effective means of reducing emissions. For example, the potential to reduce carbon emissions through energy efficiency exceeds that of fuel switching by a factor of 2.[66]

Air Quality—Air quality is considered poor in many areas of Central and Eastern Europe. Heavy reliance on fossil fuels production and consumption, especially coal, has had a significant impact on air quality. In addition, limited availability of pollution control equipment and the questionable performance of equipment in place contributes to the high pollution levels experienced in this region. The FSU produces about 70 percent more emissions from stationary sources per unit of GNP than does the United States.[67]

When fossil fuels are burned, significant quantities of sulfur dioxide, nitrogen dioxide and particulate are released into the air. Sulfur dioxide emissions are responsible for damaging large areas of forest. About 82 percent of Poland's forests show damage, 73 percent of the former CSFR's, and 36 percent of Hungary's.[68] In Northern Siberian oil fields, thousands of gas flares bum all day, every day. The SO_2 from these flares helped ruin 1,500 square miles of Siberian timber.[69]

In the heavily industrialized areas of Poland's Upper Silesia and the Czech Republic's Northern Bohemia, industrial byproducts are regularly pumped into the air. The concentration of smoke in parts of Upper Silesia exceed EC standards by 600 percent.[70] The situation is much the same in Russia, where about 70 million people in 103 cities breathe air that is five times above the allowed limit for dangerous chermicals.[71]

Water Quality—Water quality has deteriorated dramatically in this region. Industrial and agricultural activities are major sources of pollution. Raw sewage and industrial effluents that contain heavy metals and chemicals are pumped daily into rivers and streams. Some rivers are so polluted that they cannot be used for drinking or even for industrial purposes. About half of all Polish cities, including Warsaw, do not have wastewater treatment facilities.[72] In the FSU, about half of all sewage is improperly treated, and about 20 percent is dumped untreated into the environrment.[73] Many large cities in the Baltics, such as Kaunas, Lithuania, and Riga, Latvia do not have sewage treatment facilities.

Polluted rivers eventually wind their way to the sea. The Caspian, Black and Baltic Seas are polluted. As a result, plant and animal life is threatened. Fish populations are declining and beaches are closed periodically.

Ground water contamination is increasing as well. Farms are the primary culprit. Fertilizer, pesticide, and animal waste runoff are major contributors. Because fertilizer and pesticide prices were subsidized, more and more of these products were used, regardless of whether crop yields increased. The inappropriate use of pesticides also presents health concerns. In the FSU,

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66 Pacific Northwest Laboratory, Energy Conservation: *The Main Factor for Reducing Greenhouse Gas Emissions in the Former Soviet Union,* PNL-SA-20400, December 1991.

67 Matthew J. Sagers and Wallace A. Reed, "News Notes, " *Soviet Geography,* vol. 30, No. 6, June 1989, pp. 513.

68 Organization for Economic Cooperation and Development, *Reforming the Economies of Central and Eastern Europe, 1992,* p. *98.*

69 *U.S. News and World Report,* "Toxic Wasteland, " vol. 112, No. 14, Apr. 13, 1992, p. 40.

70 Richard Ackermann, "Environment in EC: Despair or Hope?, " *Transition: The Newsletter About Reforming Economies, vol. 2, No. 4,* April 1991.

71 *U.S. News and World Report,* supra note 69, p. 42.

72 World Resources Institute, in collaboration with the United Nations Environment Programme and the United Nations Development Programme, *World Resources 1992-93, A Guide to the Global Environment (New* York: Oxford University Press, 1992), pp. *64-65.*

73 See French, "Environmental Problems and Policies in the Soviet Union, " *Current History,* vol. 90, No. *558,* October 1991, p. 333.

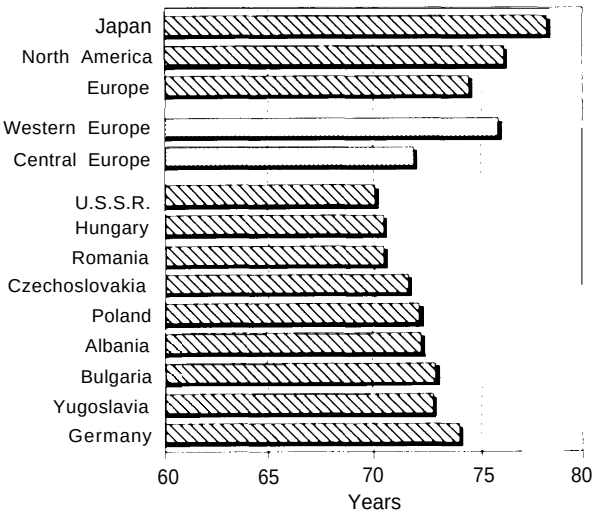
about 30 percent of foods have high concentrations of pesticides.[74]

Health—Environmental factors appear to be one of several causes of deteriorating health in Central and Eastern Europe. Among 33 industrialized countries, life expectancy is shortest in this region. (See figure 3-6.)

In addition, infant mortality rates are high relative to other countries. In Czechoslovakia, for example, infant mortality was 11.9 per 1,000 in 1988; in Hungary, 15.8, and 16.2 in Poland. For comparison, the rate was 7.5 in Germany, and 8.8 in Japan.[75]

The impact is most acute in the heavily mined and industrialized areas of the northern Czech Republic and southwestern Poland. In the most polluted areas of the former CSFR, for example, life expectancy is reported to be 5 years less than in other parts of the country. (Life expectancy also suffers from much heavier smoking prevalence rates.) In addition, high levels of SO_2 emissions has been related to a 5-fold increase in respiratory disease among preschoolers and a 3-fold increase among school-age children compared to western CSFR. In Hungary, environmentally related health problems are estimated to account for about 13 percent of health and social welfare expenditures.[76]

Figure 3-&Life Expectancy at Birth, 1985-90



SOURCE: World Resources Institute, in collaboration with the United Nations Environment Programme and the United Nations Development Programme, World ***Resources 1992-93, A Guide to the Global Environment, (New York:*** Oxford University Press, 1992).

[74] Ibid, p. ***335.***

[75] World Resources Institute, supra note 72, p. 62.

[76] Organization for Economic Co-operation and Development, supra note 68, pp. 97-98.

Technologies for Energy Efficiency

4

Heavily subsidized energy prices and incentives to meet production goals regardless of costs have resulted in high levels of energy waste in Central and Eastern Europe (CEE). This has in turn contributed to environmental damage, high operating costs, loss of foreign exchange, and energy shortages. Fortunately, highly efficient technologies are available that can provide needed energy services (such as light, heat, and motor drive) while using less energy. In many cases these technologies are widely used in the West, and their use in CEE would have substantial benefits.

This chapter provides an overview of energy efficient technologies. How energy is used, the relative efficiency of that use, technologies for improved efficiency, and what would be needed to implement these technologies in CEE are reviewed for each of the three major energy-consuming sectors—industry, buildings, and transport. It is shown that there are numerous opportunities for significant energy savings through the use of simple, low-cost, retrofit technologies. In many cases these technologies offer paybacks (the amount of time required for the value of the energy savings to exceed the initial cost) of less than 1 year.



Larry Markel

The use of coal for residential heating is common.

INDUSTRIAL ENERGY USE

Beginning with the first 5-year plan in the former Soviet Union (FSU) in the late 1920s, and in the former East Bloc countries in Central and Eastern Europe in the late 1940s, the centrally planned economies focused on large-scale industrial developments in basic materials production and fabrication. The former Soviet economy achieved rapid growth in the 1930s, largely due to construction of numerous industrial complexes concentrated around several iron ore and coal mining areas. Similar, though less rapid, growth took place in Central and Eastern Europe after

Table 4-l—Energy Use by Sector in Selected Countries, 1989

	FSU		Former CSFR		Hungary		Poland		West Germany		U.S.A.	
	PJ	Percent	PJ	Percent	PJ	Percent	PJ	Percent	PJ	Percent	PJ	Percent
Industry	18,620	49	1,060	49	360	40	1,240	40	2,800	35	17,520	31
Transport	6,180	16	170	8	120	13	400	13	2,050	25	20,470	37
Agriculture	3,850	10	140	7	60	6	130	4	100	1	660	1
Commercial Buildings	3,910	10	290	13	70	7	220	7	1,010	13	6740	12
Residential	5,570	15	380	17	270	30	1,100	35	1,900	23	10,500	19
Other	240	1	140	6	30	4	0	0	240	3	170	0
Total	38,390	100	2,180	100	900	100	3,090	100	8,100	100	56,050	100

NOTES: Excludes conversion losses. Data are uncertain. FSU refers to the Former Soviet Union. Former CSFR refers to the former Czechoslovakia. West Germany refers to the former West Germany. Data for West Germany are for 1988. PJ-petajoule - 10^{15} joule.

SOURCES: OTA estimates, based on International Energy Agency, Energy Statistics ***and Balances of OECD Countries 1987-1988,*** **OECD (Paris,** 1990; International Energy Agency, ***Energy Statistics*** **and Balances** ***of non-OECD Countries 1988-1989,*** **OECD (Paris, 1991**); International Energy Agency, ***Energy Statistics and Balances of OECD Countries 1989-1990,*** OECD (Paris, 1992); World Bank, "Greenhouse Gas Strategy for Eastern Europe and the Former Soviet Union," August 1992, draft.

the end of World War 11. Heavily subsidized energy supplies, lack of market incentives, and the importance given to fulfilling quotas and state plans resulted in little attention to energy efficiency. The result today is a technically outdated and energy inefficient industrial infrastructure.

Industry is currently the single largest energy-consuming sector, accounting for almost half of energy use in the FSU and the former CSFR, and about 40 percent of energy use in Hungary and Poland (see table 4-1, and box 4a).

Box 4-A-How Does the Industrial Sector Use Energy?

At present the industrial sector in **CEE, as in the United States, covers thousands of different products,** processes, and technologies. Several specific industries, however, account for the bulk of industrial energy use. The iron and steel industry is the single largest industrial energy user in CEE, accounting for 20-25 percent of all industrial energy use. This industry uses most of its energy in two forms: coal is used as a feedstock (meaning the coal is used as a raw material input) to produce coke (which is then used to form steel), and coal and other fuels are used to produce heat. The second largest industrial energy user in CEE is the chemical industry, which produces a wide range of products including plastics, rubber, paint soap, fertilizers, and pesticides. Feedstocks account for about half the energy used in the chemical industry-for example natural gas is a principal feedstock for the production of ammonia, which is used as a fertilizer. The remainder is used for process heat motor drive, and a variety of other uses. Machinery and transport equipment is generally the third largest energy user, largely for motor drives. Other significant sectors include the minerals industry, whose principal products are cement and glass, and the non-ferrous metals and food and tobacco industries.

An alternative perspective on industrial energy use is in terms of services rather than industries (table 4-2 shows such a breakdown for the United States, as data for CEE are not available). Steam is used for lower-temperature heating, such as in cooking and various chemical processing systems. Process heat, typically produced from coal or natural gas, is used for a variety of purposes including heating, drying, curing, and melting. Motor drive is used in every industry for pumps, fans, compressors, and other purposes. Finally, **energy is** used as **a** feedstock **in many indus-**tries, notably natural gas for fertilizer production and coal for coke used to make steel.

Table 4-2—Breakdown of Industrial Energy Use by End-Use in the United States, 1985

Service	Percent Of Industrial Energy Use
Steam	33
Process Heat	27
Motor Drive	22
Feedstocks	13
other	5

SOURCE: Office of Technology Assessment, 1993.

How Efficient Is Industrial Energy Use in CEE?

Industries in CEE typically require much more energy to produce one unit of output than do industries in Western Europe, Japan, or the United States. For example, ammonia production in Central Europe uses 25 to 75 percent more energy to produce one ton of ammonia than is used by U.S. or Japanese ammonia plants (see table 4-3). Similarly, the iron and steel industry in the FSU requires about 50 percent more energy per ton of iron output than is required in the United States (see box 4b).

There is also case-study evidence documenting the low energy efficiency of many industries. A series of industrial energy audits in Czechoslovakia found that, ''obvious energy wastes (such as steam leaks) are present in most plants, and simple low-cost improvements have not been implemented. "[1] The FSU still uses energy inefficient open hearth furnaces to produce the bulk of its steel,[2] although these furnaces require about 60 percent more energy per ton of output than do oxygen converter furnaces.[3] A study of eight industrial facilities in Hungary found that basic equipment such as boilers, turbines, and pumps was often old, obsolete, and in need of repair.[4]

The potential for industrial energy efficiency improvements in CEE is in some ways analogous to the situation faced by U.S. industry in the early 1970s. From the late 1950s to 1970 industrial energy prices in the United States were flat (or decreasing in real terms[5]), and during this time aggregate energy intensity in U.S. manufacturing (defined as energy use in manufacturing per unit of production) was essentially flat as well.[6] However beginning in 1972 energy prices in the United States generally increased, and due both to these price increases and to technical advances, aggregate energy intensity in manufacturing dropped by about one-third from 1972 to 1985.[7] By one estimate, about two-thirds of this sharp drop in intensity was due to changes in the output mix—a shift away from energy-intensive products, such as iron and steel; and towards more material-intensive products, such as computers and electronics.[8] The remaining one-third was due to improved technical energy efficiency.

Table 4-3-Approximate Energy Intensity of Ammonia Production in Selected Countries

Country	Energy Intensity of Ammonia Production (GJ/tonne)
Former CSFR*	51
Hungary	47
Poland	36
United States	29
Japan	28

" The former Czechoslovakia.

SOURCE: S. Kolar, "Industrial Energy Efficiency in Central and Eastern Europe," contractor report prepared for the Office of Technology Assessment, September 1992, p. 7.

[1] RMA (Resource Management Associates, Inc.), ''Final Report, Phase Four: Industrial Energy Efficiency Component, Policy and Institutional Analysis of Industrial Energy Efficiency in Czechoslovakia," contractor report for U.S. AID, May 30, 1992, p. 19.

[2] In 1986, 54% of steel made in the FSU made use of open-hearth furnaces. M. Sagers and A. Tretyakova, "Fuel and Energy Use in The Soviet Metallurgy Industries," Center for International Research Staff Paper No. 28, U.S. Bureau of the Census, July 1987, p. 14.

[3] Ibid, p. 33.

[4] RCG/Hagler, Bailly, Inc., ''A Profile of Energy Efficiency in Hungarian Industry,' contractor report for U.S. AID, Dec. 20, 1991, p. 7.

[5] Energy prices to manufacturers were generally dropping, in real terms, from 1945 to 1970. See R. Marlay, "Trends in Industrial Use of Energy," *Science*, vol. *226*, Dec. 14, 1984, p. 1,279.

[6] M. Ross, "Improving the Efficiency of Electricity Use in Manufacturing, " *Science,* vol. *244,* Apr. 21, 1989, p. 311. Others have argued, however, that manufacturing intensity, adjusted for structural change, dropped consistently from 1958 to 1985. See for example R. Howarth, "Energy Use in U.S. Manufacturing: The Impacts of the Energy Shocks on Sectoral Output, Industry Structure, and Energy Intensity, " *The Journal of Energy and Development, vol. 14, No. 2. The* discrepancies between these two results are due in part to whether or not structural change is controlled for, and in part to the use of different definitions and data sources to measure intensity.

[7] M. Ross, supra note 6, p. 311.

[8] R. Marlay, supra note 5, p. 1,282.

Box 4-B-The Iron and Steel Industry

Iron **and steel is the single largest energy consuming** industry in CEE, accounting for about 20-25 percent of industrial energy use.[1] This industry is quite inefficient. The FSU, for example, uses about 50 percent more energy to produce 1 ton of iron than is used in the United States (table 4-4). Much of this difference is **due to the use of outdated and inefficient technologies.**

Table 4-4-Energy Intensity of Selected Iron and Steel Processes (GJ/ton, 1989)

Process	FSU	Czech	Hungary	Poland	USA	Japan
Iron Making	21	15	21	17	14	15
Steel Refining	4	8	4	7	3	NA
Aluminum Production	59	NA	53	58	45	NA

NA. Not available.

SOURCES: S. Kolar, Industrial Energy Efficency in Central and Eastern Europe," contractor report prepared for the Office of Technology Assessment September 1992, p. 7; Energetic, Inc., "Industry Profiles: Final Report-Steel," contractor report for the U.S. Department of Energy, December 1990, pp. S-9.

The U.S. steel industry, in response to rising steel imports and other pressures, went through a drastic downsizing and modernization in the 1980s. In just 8 years the U.S. steel industry reduced its energy intensity by over one third by shutting down inefficient plants and **investing in new technology** (table 4-5). A further improvement of over one-third, relative to current levels, is thought possible with use of advanced technology. The steps that permitted the U.S. steel industry to sharply reduce its energy intensity are, for the most part applicable to CEE. These include dosing down of older inefficient plants, retrofitting of existing plants with improved technologies and practices, and building new, highly efficient plants. Improved technologies include dry coke quenching, heat recovery, continuous casting, direct steelmaking, and increased scrap recycling.[2]

Table 4-5-Energy Intensities of Steel Production

Description/Method	Intensity (GJ/ton)
1. **U.S. average, 1980.**	**38**
2. U.S. average. 1989.	**24**
3.2010 'State-of-the-Art'	**15**

Includes **conversion losses for electricity.**

SOURCES: Energetics, ho., "Industry Profiles-+inal Report: Steel," contractor report for U.S. Department of Energy, December 1990, p. *6;* **Office of Technology Assessment, 1993.**

1 International *Energy* Agency, *Energy Statistics and Balances of non-OECD Countries 1988-1989,* OECD (Paris, 1991).

2 For a more complete discussion of these technologies see U.S. Congress, Office of Technology Assessment, *Fueling Development,* OTA-E-516 (Washington, DC: U.S. Government Printing Office, April 1992), pp. 117-123.

The industrial sector in CEE has long paid little attention to energy costs and energy efficiency. Seemingly overnight, however, there has been an abrupt change in the operating environment. Energy prices are rising rapidly, and will probably contirme to rise until they reach world levels. This makes numerous energy efficiency improvements, long neglected, suddenly very attractive. In addition, industries are moving towards a market economy, and must now make allocation and production decisions based on financial analysis rather than on externally imposed quotas. In responding to these new market pressures, CEE industries can utilize the considerable technical and operational advances that have been discovered and fine-tuned in the West in the last 20 years.

The following section reviews just a few of these industrial technologies. A more comprehensive review of industrial technologies can be found in other OTA reports.[9]

Energy Efficient Technologies for Industry

This section reviews generic technologies that could be used to improve energy efficiency in industry. These include housekeeping, improved measurement and control, improved steam systems, and improved motors.

HOUSEKEEPING

There are many simple, low cost measures such as insulating pipes, plugging leaks, turning off equipment when not in use, and maintaining equipment that can result in large energy savings in industry. For example, a study of energy efficiency improvements in Canadian industry estimated that 40 percent of the improvements in industrial energy efficiency occurring from 1973 to 1985 were due to low or no-cost housekeeping measures.[10] Energy savings and paybacks will vary depending on the specific measures and applications, however case studies are illustrative of the savings potential. An audit of a metalworking plant in Budapest, Hungary found that 40 percent of compressed air was lost through leakage; locating and patching these leaks was predicted to save 135 kW with a payback of less than one year.[11] Low cost/no cost measures, notably steam trap maintenance and leak repair, reduced energy consumption per ton of product by 15 to 20 percent at a pharmaceutical plant in Czechoslovakia.[12] A series of industrial audits in Hungary found the level of maintenance to be below Western levels,[13] suggesting that many such opportunities remain.

IMPROVED MEASUREMENT AND CONTROL

Improved measurement and control of industrial processes using electronic sensors and monitors, switches, and computers offers large potential energy savings. Examples include combustion analyzers for furnaces and boilers, energy management systems to automatically operate energy-using equipment, and improved sensors and controls to allow for fine-tuning of temperatures and controls. Savings are site-specific, but generally considerable. For example, the installation of an energy management and control system at a chemical plant in Budapest, Hungary was predicted to reduce energy consumption by 15 to 20 percent, with a payback of less than 6 months.[14] Similarly, thermostatically controlled valves for a hot water system at a machining plant in Czechoslovakia offered considerable savings with a payback of less than 3 months.[15]

STEAM SYSTEMS

Steam is probably the single largest industrial end-use (as shown in table 4-2, steam accounts for about one-third of all industrial energy use in the

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9 U.S. Congress, Office of Technology Assessment, *Fueling Development, OTA-E-516* (Washington, DC: U.S. Government Printing Office, April 1992); U.S. Congress, Office of Technology Assessment, Industrial *Energy Use, OTA-E-198* (Washington DC: U.S. Government Printing Office, June 1983).

10 Marbek Resource Consultants, ''Energy Demand in Canada, 1973-1987; Volume 1,' contractor report for Energy, Mines and Resources, March, 1989 (Revised August, 1989), p. B-34.

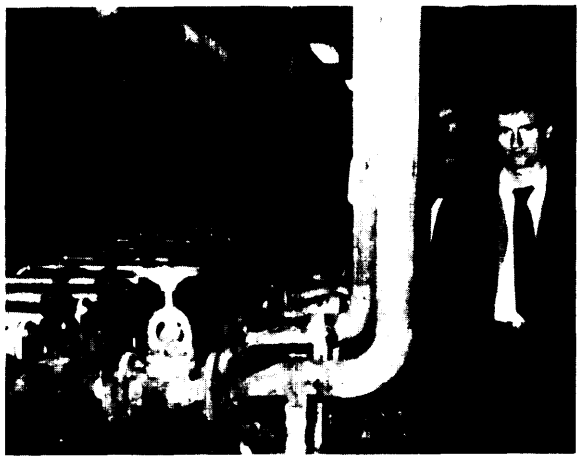
11 RCG/Hagler, Badly, Inc. and EGI Contracting and Engineering, "Energy Efficiency Audit Report: Csepel Muvek Femmu Metalworks Plant,'' contractor report for U.S. AID, March 1992, pp. 30-31.

12 RMA (Resource Management Associates, Inc.), supra note 1, p. 20.

13 RCG/Hagler, Bailly, Inc., supra note 4, p. 20.

14 RCG/Hagler, Bailly, Inc. and EGI Contracting and Engineering, "Energy Efficiency Audit Report: Budapest Chemical Works, " contractor report for U.S. AID, March 1992, pp. 18-19.

15 Resource Management Associates, Inc. and Energoprojekt, "Energy Efficiency Audit Report: Prazske Pivovary Branik, Prague, Czechoslovakia,'' Contractor report for U.S. AID, January 1992, p. 16.



Steam traps, indicated by the arrow, save energy *in industrial steam systems. One American company has successfully exported these devices to* ***the*** *region (see the appendix of this chapter).*

United States; the fraction in CEE is probably larger). There are several technologies that can improve the efficiency of steam systems. The first, discussed above, is housekeeping-insulating tanks and pipes, repairing steam leaks, installing and maintaining steam traps (see app. 4-l), operating boilers at optimal temperatures and pressures, and general tune-up and cleaning of burners. By one estimate, increased insulation alone can reduce boiler fuel use by 8 Percent.[16] Higher first cost-but typically very cost-efffective--options include adding electronic temperature controls and installing improved burners (which alone can increase efficiency 3 percent[17]). Installation of a new high efficiency burner with automatic controls on a 20-year old boiler in a fabric plant in the former CSFR was estimated to increase efficiency by 3 to 6 percent, with a payback of 7 months.[18]

Table 4-6-Age Distribution of Boilers (1989)

Age	Fraction of Capacity	
	Former CSFR	United States
50+ years.	11	5
30-50 years	26	30
10-30 years.	52	52
0-10 years	11	13

SOURCE: S. Kolar, "Industrial Energy Efficiency in Central and Eastern Europe," contractor report prepared for the Office of Technology Assessment, September 1992, p. 29; RCG/Hagler, Bailly, Inc., "Combustion System Technology and Application Assessment: ndustrial Boiler Combustion Systems," contractor report for the Gas Research Institute, October 1988, p. 26.

Many boilers in CEE (and in the United States as well, see table 4-6) are quite old, and may soon need replacement. Fluidized-bed boilers are a particularly promising advanced boiler technology. Many boilers, particularly in Poland, are fueled by coal. Fluidized-bed coal-fired boilers can increase efficiency, reduce emissions, and increase tolerance to low quality coal.[19] Tests of fluidized bed boilers have shown that they can operate with very high ash coal-up to 40 percent.[20] This could be a significant advantage in the former CSFR, where wide-spread use of coal with high water and ash content contributes to the low operating efficiency of boilers.[21]

The use of cogeneration systems can also yield significant gains in efficiency. Cogeneration refers to the simultaneous production of heat (typically steam) and electricity. In industries with an onsite need for both steam and electricity, the overall efficiency of a cogeneration system is

16 Energetics, Inc., "Industry Profiles—Final Report: Steam Generation and Cogeneration," contractor report for U.S. Department of Energy, December 1990, p. 11.

17 United Nations, *East-West Energy Efficiency*, ECE Energy Series No.1O, New York, 1992, P. 101.

18 Resource Management Associates, Inc. and Energoprojekt, "Energy Efficiency Audit Report: Cemy Dul Fabric Plant, Horice, Czechoslovakia," contractor report for U.S. AID, January 1992, pp. 14-15.

19 U.S. Congress, Office of Technology Assessment *Fueling Development,* OTA-E-516 (Washington, DC: U.S. Government Printing Office, April 1992), pp. 191-192.

20 Ibid, p. 192.

21 S. Kolar, "Industrial Energy Efficiency in Central and Eastern Europe, " contractor report prepared for the Office of Technology Assessment, September 1992, p. 26.

typically much higher than that of a steam-only system.[22] By one estimate there is a potential to provide 6 percent of the former CSFR's electricity needs with cogeneration systems.[23] The relatively low penetration of cogeneration in CEE is due in part to a history of low electricity prices (which have made self-generation less financially attractive) and to the difficulty faced by private power producers in selling electricity to the grid. These issues have been addressed in part in the United States by the Public Utility Regulatory Policies Act (1978), which requires electric utilities to purchase electricity from cogenerators at a reasonable rate. Since passage of the Act, cogeneration installations in the United States have grown rapidly, from 12 GW installed capacity in 1980 to 25 GW by the end of 1989.[24]

MOTORS

Electric motors consume the bulk of industrial electricity in CEE. In the former CSFR, for example, electric motors are responsible for over two-thirds of industrial electricity use.[25] These motors are used for pumps, fans, compressors, materials processing (crushing, grinding, etc.), and materials movement (cranes, elevators, etc.). Recent technical advances allow for significant improvements in motor efficiencies.[26] Standard motors typically operate at efficiencies of 77 to 94 percent, while high efficiency motors operate at 84 to 96 percent. These high-efficiency motors make use of both better design and better materials to reduce internal electric and magnetic losses. High-efficiency motors typically cost about one-third more than standard motors, but depending on usage, electricity rates, and other factors, this investment often pays back rapidly. Another technical improvement in motors, adjustable-speed drives, allows for better matching of motor speed and load and thereby can provide electricity savings of 30 to 50 percent in fans.[27]

Industrial Energy Use: Conclusions and Implementation

Industry is the single largest energy user in CEE. Although data are scarce, it is fairly clear that much of this energy is wasted, and that there are many cost-effective opportunities for improved energy efficiency. In the past, industry neglected energy efficiency as energy costs were low and the focus was on meeting production goals. Now, however, energy costs are rising rapidly and economies are moving towards a market-based system. When faced with rapidly rising energy prices, U.S. industry responded by retrofitting industrial facilities with simple housekeeping and maintenance measures, closing down old inefficient facilities, and investing in new technologies. Most of these actions could be applied in Central and Eastern Europe; furthermore, industry can make use of the many improved technologies discovered and refined in the West in the last 20 years.

In the short term, the first priority for industry is to implement the numerous low and no-cost retrofit measures described above. These include insulating pipes, installing steam traps, installing simple electronic meters and controls, and providing basic maintenance. These measures offer very short paybacks (usually less than 2 years, and in some cases less than 6 months) and significant energy savings.

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22 Cogeneration is discussed in detail in U.S. Congress, Office of Technology Assessment *Industrial and Commercial Cogeneration, OTA-E-192* (Washington DC: U.S. Government Printing Office, February 1983).

23 S. Kolar, supra note 21, p. 29.

24 Energetic, Inc., supra note 16, p. 2.

25 S. Kolar, supra note 21, p. 21.

26 For a detailed discussion of high efficiency motors see U.S. Congress, Office of Technology Assessment, Fueling *Development, OTA-E-516 (Washington* DC: U.S. Government Printing Office, April 1992), pp. 107-115.

27 Ibid, p. 113.

Implementing these low cost measures will require all of the following:

. awareness of their availability and energy savings potential;
• incentives to take the time and effort to install them;
. hardware, or the capital to buy them; and
. knowledge of where and how to use them.

A recent study of industrial energy use in Poland found, ''most responsible personnel lacked awareness of the specifics and extent of energy wasted and of the measures necessary to use energy more efficiently. ''[28] The frost step in implementing energy efficiency is to make sure those who can make investment decisions are aware of the opportunities. *Awareness* of availability and energy savings potential can be spread through professional journals, training, word-of-mouth, demonstration programs, exhibitions and trade fairs, and other informal communication channels.

One complicating factor is determining just who to target for new information. Many industries are in transition from public to private ownership, and the responsibility and authority to make investments of any type may be spread among the government (which in many cases retains part ownership), the new part-owners, the plant manager, and the energy manager (if there is one). Furthermore in many Hungarian industries, for example, decision making is very hierarchical and centralized,[29] requiring energy efficiency to compete with many other issues for the attention of senior management.

Technology transfer from the United States to Central and Eastern Europe to date has been largely in the form of private sector efforts to sell U.S. technologies (see app. 4-l). These efforts have benefited from U.S. programs to build awareness and understanding of energy efficiency through meetings, trade fairs, and audits. Although these efforts are difficult to evaluate, their relatively low costs and case-study evidence of their benefits suggest that they are worthwhile.

For an individual or an industry to take the time and effort to focus on efficiency requires some *incentive* to do so. For the simple low-cost measures discussed above, it might seem that the rapid paybacks (corresponding to financial returns of well over 100 percent in many cases) should be sufficient. However if the energy savings do not flow to the plant or to the individual making the decision, then there is little incentive to invest. In Russia, for example, there is some concern that reducing energy consumption may lead to reduced energy allocations in the future. Similarly, profits in Russia (e.g., those resulting from energy savings) are taxed at a 50 percent rate.[30] Providing decision makers with the correct price signals, and allowing the benefits (and costs) of efficiency to flow to those making the decisions, will help provide the needed financial incentives.

The countries of CEE must make their own decisions on price reform and abolition of production quotas. However the United States can play a role by sharing information on the effectiveness of alternative pricing structures (e.g., off-peak electricity rates), providing foreign aid during the difficult time of adjustment to new price levels, and making it clear that appropriate financial incentives are absolutely necessary for a market to function properly. This is conceptually straightforward but quite difficult in practice. In the face of rapidly increasing energy prices, some industries are forced to either not pay their utility bills (causing financial problems for the utility) or

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28 International Resources Group, Ltd., "Poland: Policy and Institutional Analysis, Final Report, " contractor report for U.S. AID, May 1992, p. 11<

29 RCG/Hagler, Baitty, Inc., supra nOte 4, p. 16.

30 E. Martinet, "Energy Efficiency in Russia, Belorus, and Estonia: programs, Perspectives, and Western Assistance," contractor report prepared for the Office of Technology Assessment, Dec. 9, 1992, p. 17.

simply pile up debt with suppliers, banks, and others. Calls for price reform must be tempered with the reality that, at least in the short term, the money just may not be available.

The use of low-cost retrofit technologies is, in many cases, straightforward. One does not need a highly trained engineer to install steam traps and insulation. What is needed, and is presently in short supply, is the required *hardware*. There are already some efforts being made by U.S. companies to export these devices to CEE (see app. 4-1). Many of these efforts, however, are hampered by lack of *capital.* CEE industries may recognize the energy-savings potential and have a financial incentive to make the investment, yet not have the needed capital.[31]

Several innovative financing schemes could be used to supply capital to CEE industries for energy efficiency investments. Performance contracting, in which the company supplying the hardware shares the financial savings resulting from the decreased energy use, is being investigated (see app. 4-1). One project is even considering payment in the form of natural gas. This avoids problems of currency convertibility, which have hampered several projects.

In the United States, utilities sometimes supply the capital for efficiency when it is less expensive than new electricity generating facilities. Some have argued that CEE utilities could supply capital for efficiency. However these utilities are generally overcapacity due to the economic recession, and therefore cannot easily justify short-term efficiency investments in terms of avoided new supply. Furthermore, many of the short-term retrofit options save primary fuels rather than electricity. If, however, a utility is considering investing in capital equipment to reduce pollution from an existing plant-such as retrofitting scrubbers to a coal-fired plant-it is certainly worth investigating whether it would require less capital to invest in efficiency and thereby reduce electricity demand, which would in turn reduce coal consumption.

There are several ways the U.S. Government could assist efforts to provide capital and hardware for energy efficiency. Joint ventures between U.S. and CEE industries could be encouraged through export promotion and risk-reduction programrms.[32] The United States could provide low-interest loans directly to CEE industries for energy efficiency retrofits, to be repaid through the energy savings resulting from the retrofit .33 The Federal Government could institute a‘ Green Exports program, whereby U.S. companies transferring energy efficient technologies to CEE get positive publicity and technical assistance from the government. The multilateral banks could be encouraged to supply capital for energy efficiency retrofits.

Technical knowledge of how to evaluate, install, and maintain energy efficiency technologies is needed as well. Although most retrofit technologies are relatively simple, some expertise is needed to decide where and how to use them. Methods to provide this expertise include audits, general educational materials such as videotapes and books, technical courses, and exchange programs.

In the long term, major increases in energy efficiency will come not just from retrofits but from replacement of technically outdated industrial facilities with new facilities using modem technologies and practices. Investments in new industrial facilities most likely will be made for reasons other than energy efficiency (e.g., to reduce overall costs or to increase product quality), nevertheless large efficiency and environmental benefits will result from investments in new industrial equipment and processes.

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31 In many cases capital is either unavailable, or available only at very ~@ interest rates.

32 Many such programs already exist—see chapter 5 of this report, also, The Alliance to Save Energy, “A Resource Guide for Exporting Energy-Efficient Products, ” Washington DC, July 1991.

33 For example, a revolving loan fund is used by the state of Texas to supply capital for retrofits of state-owned buildings.

Larry Markel



Most people live in apartments. Single-family ***houses are less common than in the West.***

The capital requirements for rebuilding industrial facilities will be enormous. Given the relatively constrained foreign aid budget in the United States, it would be difficult for the U.S. Government to cover a significant fraction of the costs to rebuild industrial facilities. An alternative role is for the U.S. Government to support and encourage private sector investment through information, risk-sharing and risk-reduction programs, and to encourage CEE country governments to provide an attractive investment climate.

BUILDING ENERGY USE

Energy used in buildings-to heat, cool, light, and provide other important energy services—accounts for about one-fourth to one-third of all energy used in Central and Eastern Europe. As with the industrial sector, there is great potential for increasing the efficiency of energy use in buildings through use of commercially available technologies already widely used and accepted in the West.

Physical Description

Most urban and suburban housing is in the form of large, multifamily apartment buildings. These buildings are considerably less expensive to build, per unit, than single-family buildings; and therefore provide basic housing services at a lower frost cost. Only in rural areas are single-family homes common. This is in contrast to the United States, where single-family homes are the dominant housing type (table 4-7). Apartment units are relatively small, providing about one-fourth as much floor space per person as housing in the United States (table 4-7). Appliance saturation is presently close to that of the United States for major energy uses such as refrigerators and washing machines (table 4-8); however, residential air conditioning is almost unknown, in contrast to the United States where over two-thirds of households have air conditioning.[34] (See also box 4c).

Commercial buildings (i.e., offices, stores, schools, and so on) are much less common in CEE than in the United States. By one estimate, the FSU has less than 1/5 as much commercial building floorspace per capita as does the United States.[35] There is very little information available

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34 U.S. Congress, Office of Technology Assessment, *Building Energy Efficiency, OTA-E-5 18 (Washington* DC: U.S. Government Printing Office, May 1992, p. 41); includes central and room units. Note that much of CEE lies north of the U. S., and therefore does not need air conditioning.

35 L. Schipper and R.C. Cooper, "Energy Use and Conservation in the U. S. S.R.: Patterns, Prospects, and Problems, " LBL-29830 (Berkeley, CA: Lawrence Berkeley Laboratory, April 1991), p. 23.

Table 4-7-Comparison of Housing in the FSU and the United States, 1989

Indicator	FSU	United States
Percent of new units that are single family houses.	15	72
Average floor space per person (all units, m^2/person).	16	61

SOURCES: U.S. Bureau of the Census, ***American Housing Survey for the*** United ***States in*** 1989, H150/89 (Washington, DC: U.S. Government Printing Office, July 1991), p. 38; U.S. Bureau of the Census, ***USA/USSR: Facts and Figures*** (Washington, DC: U.S. Government Printing Office, August 1991), pp. 2-7,2-8.

Table 4-8-Appliance Holdings in t he United States and in the FSU

Appliance	% of households having 1 or more United States(1990)	FSU (1989)
Television (color).	96	44
Refrigerator and/or Freezer. . .	99	92
Clothes washing machine. . . .	76	72

NOTE: About 15% of U.S. households have more than one refrigerator, and 50% have more than one color television set.

SOURCES: U.S. Bureau of the Census, ***USA/USSR: Facts*** and ***Figures*** (Washington, DC: U.S. Government Printing Office, August 1991), p. 8-4; U.S. Department of Energy, Energy Information Administration, ***Housing Characteristics 1990*** (Washington, DC: U.S. Government Printing Office, May 1992), pp. 104, 106.

Box 4-C--A Typical Residence in CEE

Residential buildings in Central and Eastern Europe are quite different from those in the United States. One way to illustrate these differences is by describing atypical residence in CEE-a unit in a large multistory apartment building. The design and construction of the building emphasizes low construction costs and simplicty. Steel and concrete are the principal materials, windows are poorly sealed and caulked, and building insulation is lacking or very thin. At present the building is publicly owned (that is, owned by a local or regional government agency), however the movement towards privatization has affected the buildings sector as well, and in the near future the units may be sold to the tenants. The building is in relatively poor shape; funds and parts for repair are limited, and only when components totally break down are they repaired or replaced. The apartment itself is quite small, providing only about 1/4 the floor space per person found in the typical U.S. residence. Within the apartment are a small refrigerator, a washing machine, and several small appliances including a sewing machine, a black and white TV, and a radio. Space heating is provided by radiators, which usually provide plenty of heat even on the coldest days-in face it is often necessary to open some windows, even in the winter, to keep from overheating. There is no thermostat or working valve on the radiators, and therefore no way to control the temperature other than by opening the windows. Hot water for washing is plentiful as well, winter and summer. Assummers are rarely hot, there is little need for air conditioning. Cooking is done on a natural gas-fired range.

SOURCE: Office of Technology **Assessment.**

on these buildings, but they are probably similar to residential buildings in that they offer only basic services--i.e. poorly controlled heat, few appliances, very little air conditioning, low lighting levels, and poorly insulated shells.

How Do These Buildings Use Energy?

Space heating is the single largest energy user in CEE buildings, accounting for over three-fourths of all building energy use in the FSU.[36] Of the energy used for space heating in the FSU, about 40 percent[37] comes as hot water from a

[36] M. Sagers and A. Tretyakova, "USSR: Energy Consumption in the Housing and Municipal sector, " Center for International Research Staff Paper No. 30, U.S. Bureau of the Census, September 1987, p. 21. [Note: this figure may include some water heating].

[37] Ibid, p. 21.

district heating plant-a large heat or combined heat and power plant providing hot water or steam to more than one building.[38]

The remaining 60 percent of energy use for space heating comes from onsite fuel use. Smaller buildings and those in rural areas without access to a district heating grid often use small coal-fried residential boilers, which typically are manually stoked and fired. These small coal burners have no emission controls and are extremely dirty, producing much more pollutants (notably particulate, CO, and SO_x) per unit of heat output than a well-controlled large boiler with pollutant controls. A variety of other space heating technologies, including those fired by wood, natural gas, and oil are found in some areas as well.

Water heating is a significant energy user as well. In those buildings served by district heat, hot water is often supplied centrally from the district heating system.[39] Buildings with access to natural gas service often use natural gas to heat water.

Significant energy uses after space and water heating include cooking, lighting, refrigeration, and various appliances. Over three-fourths of households in the FSU use natural gas for cooking,[40] the remainder use a variety of fuels including wood and electricity. Few data are available on lighting, but most household lighting is supplied by incandescent lamps; and lighting levels are often relatively low. Refrigerators in CEE are typically smaller and simpler than those in the United States—with an interior volume about half that of the typical U.S. model,[41] and manual rather than automatic defrost. As discussed below, their energy efficiency is quite low as well.

How Energy Efficient are Buildings in Central and Eastern Europe?

There are two ways to assess energy efficiency: relative to a standard or to other countries, and relative to opportunities for improvement. This section discusses energy use in Eastern European buildings relative to that in other countries, and the following section discusses specific technical opportunities for improvement.

Comparing aggregate energy use in buildings across countries can be misleading. Considering only, for example, building energy use per capita across countries fails to consider climatic differences (a country in a colder climate will of course use more energy to heat buildings, this does not mean it's less efficient) or service differences (U.S. households use more electricity than CEE households because they are larger and have more energy-intensive appliances such as air conditioners, similarly this does not mean they are less efficient). A better indicator that controls for some of these effects would be, for example, space heating energy use per square meter of floor space per heating-degree-day .42

Data for such a measure are difficult to obtain, however researchers at Lawrence Berkeley Laboratory have estimated that households in the FSU use about 190 kilojoules per square meter of floor space per heating degree-day. For comparison buildings in the United States use about 125; that is buildings in the FSU use about 50 percent more energy to heat one square meter of

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38 District heating is rare but not unknown in the U.S. At present, about 1 1% of commercial building floor space in the U.S. is supplied heat from a district heating plant (U.S. Congress, Office of Technology Assessment, *Building Energy Efficiency, OTA-E-518* (Washington, DC: U.S. Government Printing Office, May 1992), p. 49). District heating of *residential* buildings in the United States is very rare.

39 The hot water from the district heating plant is not used directly, but rather fresh water is heated in a heat exchanger which uses the district heating system as a heat source.

40 U.S. Bureau of the Census, *USA/USSR: Facts* and Figures (Washington, DC: U.S. Government Printing OffIce, August 1991), p. 2-8.

41 L. Schipper and R.C. Cooper, supra note 35, p. 22; U.S. Congress, Office of Technology Assessment, *Building Energy Efficiency*, OTA-E-518 (Washington DC: U.S. Government Printing Office, May 1992), p. 61.

42 Degree-days are typically measured relative to a base temperature, usually 65 degrees F°. If the daily average temperature One day is 60 degrees F, then that day has 5 (65 minus 60) degree-days.

floorspace than buildings in the United States,[43] controlling for outdoor temperature. Furthermore, work by OTA and others has shown that considerable improvements in the energy efficiency of the U.S. building stock would be cost-effective,[44] therefore the U.S. energy intensity indicators should be seen as an achievable level and not an economic optimum. This suggests that a considerable potential exists to save energy in FSU buildings through increased efficiency. Furthermore, buildings in the United States are, in general, quite comfortable, and saving energy in FSU buildings does not require any loss of comfort-in fact, as discussed below, improved control can both save energy and *increase* comfort.

Electricity use in buildings tells a somewhat different story. Residential electricity use per capita in the FSU is about one-tenth that of the United States.[45] This is not an indication of efficiency, however, but rather a reflection of the low appliance saturation in the FSU. Although households in the FSU often have refrigerators, washing machines, and televisions (table 4-8); they generally do not have air conditioners, clothes dryers, electric ranges, and other electricity-intensive home appliances common in the United States. In addition, as shown in table 4-7, households in the FSU are significantly smaller and therefore have lower lighting requirements as well.

Refrigerators are probably the single largest electricity user in CEE residences. The energy efficiency of new refrigerators currently sold in CEE lags significantly behind that of new refrigerators sold in the United States. As shown in table 4-9 (page 69), refrigerators currently sold in Poland exceed the maximurn energy use allowed in the United States by 40 percent.

Technologies for Improved Efficiency

Technologies for increasing the efficiency of energy use in buildings include: improving the operation and control of space heating systems, fuel switching, improving the building shell, improving the efficiency of electrical appliances, and improving the district heating delivery system.

IMPROVED OPERATION AND CONTROL OF SPACE HEATING SYSTEMS

Space heating systems in multistory apartment buildings usually are operated very inefficiently. The chief "technology" for temperature control is usually an open window-a ''fortichka," a small window built within the frame of a surrounding larger window for the purpose of regulating temperature (see app. 4-1). This technology leads to tremendous energy losses (opening windows rather than turning down the heat is done in U.S. apartment buildings as well%).

There are a number of technologies, more effective and efficient than opening windows, that can reduce energy consumption while maintaining, or even improving, occupant comfort. The first is an *operating radiator valve,* which can be used to control the flow of steam or hot water through a radiator. Many radiators lack valves

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43 Delivered (useful) energy only. Source: L. Schipper and R. Cooper, supra note 35, p. 58.

44 See U.S. Congress, Office of Technology Assessment, *Building Energy Efficiency,* (OTA-~-518 (Washington, DC: U.S. Government Printing Office, May 1992), chapter 1; also P. Komor and A. Moyad, ''How Large is the Cost-Effective Savings Potential in U.S. Buildings?, ' *Proceedings of the ACEEE 1992 Summer Study on Energy Efficiency in Buildings* (Washington DC: American Council for an Energy-Efficient Economy, 1992), vol. 6, p. 6.125.

45 Residences in the FSU used about 400 kWh/capita-year in 1990 (residential electricity use only, OTA estimate based in part On M. Sagers and A. Tretyakova, supra note 36, p. 12), while U.S. residences used about 3710 kWh/capita-year in 1990 (U.S. Department of Energy, Energy Information Administration *State Energy Data Report* (Washington DC: U.S. Government Printing Office, May 1992), p.32; U.S. Bureau of the Census, *Statistical Abstract of the United States 1992* (Washington DC: U.S. Government Printing Office), p. 8).

46 J. DeCicco, 'Modeling, diagnosis, and implications for improving the energy-efficiency of centrally heated apartment buildings,' Report No. 225 (Princeton, *NJ:* Center for Energy and Environmental Studies, April 1988), p. 228.

altogether and those that are installed often become jammed due to corrosion. A case study of an apartment in a high-rise in Krakow found that all but one radiator had inoperative radiator valves.[47] In a study of a centrally heated apartment building in New Jersey, 34 percent of the radiator valves were stuck.[48] Without an operable valve there is no way, other than opening windows, to control the temperature.

Thermostats can reduce energy use and increase comfort by automatically regulating heat to provide a constant indoor temperature. A thermostat frees the occupants from the task of continually adjusting the radiator, and also controls the temperature when no one is home. Thermostatic radiator valves are available at a cost of $30 to $35 each;[49] these valves control room temperature by modulating the flow of hot water or steam through the radiator. These valves can be retrofit relatively easily to many space heating systems.[50]

One notable feature of multiunit apartment buildings with central space heating systems is that individual units are rarely metered; that is the energy use of the individual apartment is not actually measured. Energy costs are typically based on a flat rate proportional to apartment size. Therefore, there is no direct financial incentive for efficient operation (such as using radiator valves rather than windows to control temperature). The use of individual apartment *meters* would provide data from which tenants could be charged for their actual consumption, **and could be** financially rewarded for efficient operation.[51] In a study of the effects of metering in apartment buildings in the United States, energy consumption dropped 6 percent in one building and 13 percent in another after individual unit meters were added.[52]

There are numerous technologies that can improve the heat distribution system of a building. Examples include *resets,* which allow the hot water temperature to vary in response to outdoor temperature, *cutouts,* which shut off the hot water when the outdoor temperature is such that no space heating is necessary, and *night setback,* which reduces hot water temperature in late night hours. Installation of resets and cutouts yielded space heating energy savings of 10 to 26 percent in apartment buildings in Milwaukee.[53] Modeling of a centrally heated apartment building in New Jersey suggested that heating energy use could be reduced 63 percent by reducing steam pressure, changing various control settings, instituting night setback, and installing thermostats.[54]

In summary, improved operation and control of space heating systems in multifamily buildings are often cost-effective retrofits. A summary of

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47 A. Hoggatt, ' 'Energy Efficiency in Krakovian Apartment Buildings: An Engineering and Economic overview, " draft report for U.S. EPA, May 26, 1992, Appendix A.II by Steve Greenberg, p. 45.

48 J. DeCicco, supra nOte 46, p. 230.

49 These are approximate prices in the United States in 1993.

50 Systems piped in series—that is, where the output of one radiator is the input to another—will require the installation of a bypass pipe.

51 Metering must be combined with an enforceable billing system.

52 D. Palermini and D. Hewitt, "Economic and Social Impacts of Converting to Tenant Metering in Multi-Family Housing, ' in Proceedings *of the ACEEE 1990 Summer Study on Energy Efficiency in Buildings* (Washington, *DC: American Council* for an Energy-Efficient Economy, 1990), p. 9.238. Of course the meters themselves did not save energy, but the metered data was then used to charge occupants for actual consumption.

53 M. Hewett and G. Peterson, ''Measured Energy Savings from Outdoor Resets in Modern, Hydropically Heated Apartment Buildings, in *Proceedings of the ACEEE 1984 Summer Study on Energy Efficiency in Buildings (Washington DC:* America nCouncil for an Energy-Efficient Economy, 1984), p. C-135; as referenced in G. Ewing et al., "Effectiveness of Boiler Control Retrofits on Small Multifamily Buildings in Wisconsin,'' in *Proceedings of the ACEEE 1988 Summer Study on Energy Efficiency in Buildings (Washington DC: American* Council for an Energy-Efficient Economy, 1988), p. 2.51.

54 J. DeCicco, "fier~ Conservation and Outdoor-Reset Control of Space Heating Systems, '' in *Proceedings of the ACEEE 1988 Summer Study on Energy Efficiency in Buildings* (Washington DC: American Council for an Energy-Efficient Economy, 1988), p. 2.33.

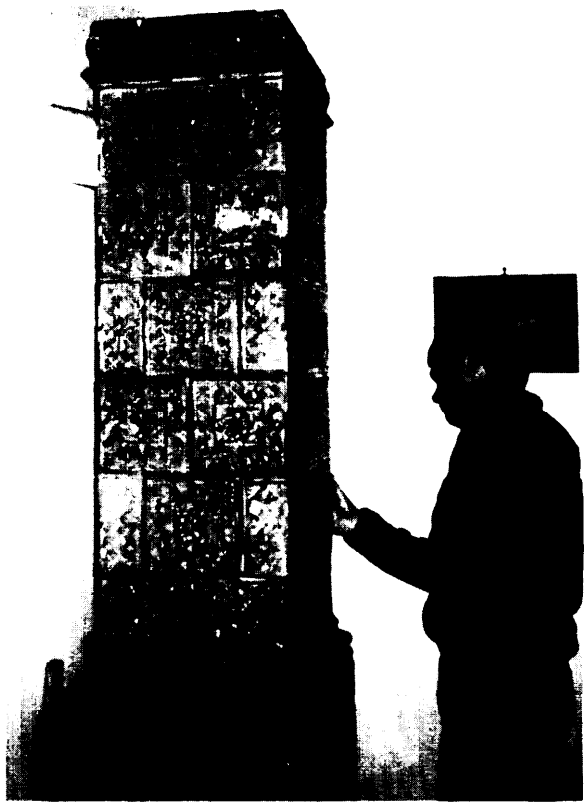
multifamily building retrofits in the United States and Europe found that heating system improvements offered significant energy savings and reasonable paybacks—typically 3 to 7 years.[55]

FUEL SWITCHING

Many buildings in CEE are heated with coal. In the case of multifamily buildings this heat is provided either by a coal-freed district heating plant or a small onsite boiler, while single-family buildings are often heated by a small coal-fired boiler.

Small onsite boilers in multifamily buildings typically lack any pollution control equipment, are fired with relatively low-quality (that is, high ash and sulfur content) coal, and are poorly maintained; the end result is very high air emissions (including particulate, CO, and SO_x) and low operating efficiency. One option is to connect these buildings to the district heating system, which although coal-fired often does have pollution control equipment. Such an effort is now being pursued in Krakow, Poland, funded in part by the U.S. Department of Energy. A second option is to convert these boilers to natural gas, which could dramatically reduce air emissions.

Many buildings using district heat for space heating also obtain their hot water from the district heating system. This requires the district heating system to operate year-round to provide hot water. Converting to individual natural gas-fired units for water heat would allow the district heating system to shut down during the summer. A second option is the use of a ‘ ‘front-end” gas-freed boiler, a small onsite boiler sized to meet hot water needs. Retrofits of front-end boilers to multifamily buildings in the United States have led to significant energy savings, although high frost costs resulted in long paybacks.[56]



Larry Markel

***Coal** stoves in residences are significant sources of pollution.*

Single-family buildings often are heated by small coal-fired stoves. For those buildings located in areas served by natural gas, conversion of coal-fried stoves to natural gas would have significant air quality benefits. However many single-family buildings are located in rural areas without natural gas service, Similar air quality benefits, however, could be gained through conversion to LPG (liquefied petroleum gas). Another option is to replace the traditional small coal stove with a high efficiency, cleaner-burning

55 J. Harris et al., ‘‘Comparing Measured Savings and Cost Effectiveness of Multifamily Retrofits in the United States and Europe,’’ *Energy Systems and Policy*, vol. 13, 1989, p. 109.

56 M. Lobenstein et al., “Measured Savings and Field Experience from the Installation of Front-End Modular Boilers,” in Proceedings *of the ACEEE 1990 Summer Study on Energy Efficiency in Buildings* (Washington, DC: American Council for an Energy-Efficient Economy, 1990), p. 9.189.

modem coal stove. Energy savings and emissions reductions from such a switch are thought to be considerable .57

SHELL IMPROVEMENTS

Energy use for space heating can be reduced significantly by reducing losses through the building shell. Several researchers have noted that buildings in CEE have relatively low insulation levels.[58] One study found that walls in a Polish apartment had an R-value[59] of about 3.6,[60] well below that of the R-value of 10 or higher commonly found in walls of U.S. houses.[61] Similarly, improved windows can reduce heat loss as well. Windows are typically double-pane with a R-value of about 2, but are often poorly fitted and sealed, which contributes to infiltration losses. Improved windows making use of low-emissivity coatings, low-conductance frames, and suspended reflective films are available with R-values up to 8.[62]

The cost-effectiveness of shell *retrofits* in multifamily buildings is sometimes questionable. Although increased insulation and improved windows do reduce energy use, their relatively high first costs often result in long paybacks. A review of retrofits of multifamily buildings in the United States and Europe found paybacks for shell retrofits (such as increased insulation, caulking, window replacements, and storm windows) to be relatively long-over 10 years in many cases.[63] In new construction and renovation, however, the use of high levels of insulation, high-R windows, and careful sealing and weatherstripping is almost always cost-effective.

IMPROVED APPLIANCES

Households typically have fewer and smaller appliances than do households in the United States or in Western Europe-however, there are still significant opportunities for improvement. For example, new refrigerators currently produced and sold in Poland exceed the current (1993) U.S. energy standard by 40 percent (table 4-9). A number of engineering improvements were used by U.S. manufacturers to allow for a 22 percent drop in refrigerator energy consumption from 1990 to 1993 (table 4-9). These include improved door insulation, improved compressors, redesign of heat transfer surfaces, and improved evaporator fans. These technologies could be used in CEE as well. The savings could be significant-for example, if FSU refrigerator manufacturers were to obtain equivalent savings, the FSU could reduce electric power capacity requirements by about 190 MW each year.[64]

Lights are a large consumer of electricity in buildings. Substitution of compact fluorescent lamps for incandescent lamps can reduce lighting energy consumption 75 percent.[65] The increased

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57 U.S. Department Of Energy, ''Krakow Clean Fossil Fuels and Energy Efficiency Project Statement of Work, ' Attachment B, p. 4. Modem residential coal stoves with automatic stoking (which reduces emissions caused by under- or over-fueling) and electronic temperature control are currently produced in the United States (for example, units produced by Harman Stove and Welding, Inc., Halifax, PA).

58 L. Schipper and R.C. Cooper, supra note 35, p. 22; M. Sagers and A. Tretyakova, supra note 36, p.13.

59 "R" is a measure of resistance to heat flow, with units of hour-square feet-degree F per Btu. The higher the R-value, the better the insulating value.

60 A. Hoggatt, supra nOte 47, p. 44.

61 U.S. Congress, Office of Technology Assessment, *Building Energy Efficiency*, OTA-E-518 (Washington, DC: U.S. Government Printing Office, May 1992), p. 18.

62 Window R-values are measured at center-of-glass, and do not include losses through the frame.

63 J. Harris et al., supra note 55, p. 109.

64 Assumptions: annual sales of 6.5 million refrigerators and freezers in the FSU (U.S. Bureau Of the Census, supra note 40, p. 8-4), savings of 200 kWh/year per unit, capacity factor of 80%0 for electricity generation.

65 U.S. Congress, offic. of Technology Assessment, *Building Energy Efficiency*, OTA-E-518 (Washington, DC: U.S. Government Printing Office, May 1992), p. 52.

Table 4-9-Comparison of Energy Use of Different Refrigerators

Model/source	Energy use (kWh/year)
New unit currently manufactured in Poland, 1992. .	694
U.S. maximum allowable by law, 1990.	636
U.S. maximum allowable by law, 1993.	497

NOTE: New unit is "partial automatic defrost" two-door 9.5 ft^3 (adjusted volume) combination refrigerator-freezer manufactured and sold in Poland in 1992. U.S. standards are the maximum allowable energy use for a unit of that size with those features if offered for sale in the United States.

SOURCES: Literature from Polar, ul. Adolfa Warskiego 6, Wroclaw, Poland; Federal Register 47918 (Nov. 17, 1989).

frost cost of compact fluorescent lamps makes them economically attractive only in areas where lights are on for many hours per day—such as corridors, entrance areas, and other public spaces. There have been many improvements in commercial building lighting technologies as well. Electronic ballasts, improved reflectors, and reduced wattage lamps can reduce lighting energy use by over one-third.[66]

DISTRICT HEAT DELIVERY IMPROVEMENTS

The district heating systems that deliver hot water for space heating to apartments are often old, leaky, and inefficient. By one estimate, in Poland 15 percent of the energy contained in the original fuel is lost in the district heating delivery system.[67] These losses are both in heat (via conduction, convection, and radiation) and in direct water leaks. Many of the technical frees to reduce these losses are relatively straightforward, such as replacing leaky pipes, repairing leaky joints, and insulating pipes. By one estimate, pipe insulation typically has a payback of less than 1 year.[68] Improved controls to better regulate temperature, pressure, and flow can reduce energy use as well. An ongoing project to upgrade a district heating system in Moscow projects energy savings of 30 percent from improved boiler and distribution system controls (see app. 4-l). Another source estimates savings of 10 to 30 percent from improved control of distribution systems.[69]

Conclusions and Implementation

A number of factors will almost certainly lead to increased energy use in buildings in CEE in the long term, including:

- large increases in commercial building floor space;
- increases in the demand for energy-intensive services in the commercial sector (notably air conditioning, information technologies, and lighting);
- increases in the size (square meters of floorspace per person) of residential housing;
- growing population; and
- growing demand for energy-intensive residential appliances, such as color televisions, clothes dryers, and larger refrigerators.

The challenge for improved technologies, therefore, is to moderate the increase in energy demand below what it would otherwise be.

There are numerous examples of large opportunities for energy efficiency improvements in buildings. As discussed above, walls in a Polish apartment building were found to have less than half the insulating value of walls in typical U.S. houses. Space heating energy intensity in the FSU is about 50 percent higher than in the United States. New refrigerators in Poland use 40 percent more energy than is allowed by the 1993 U.S. standards. By one estimate, energy savings of 30

66 Ibid, p. 56.

67 L. Lipka, "District Hinting Systems in Poland, " in International Energy Agency, *Seminar on Energy in East and West: The Poland Case,* Copenhagen April 1990.

68 United Nations, supra note 17, p. 94. If pipes are buried, paybacks will be longer.

69 Ibid, p. 95.

to 45 percent are possible in the FSU buildings sector.[70] The data are spotty but consistent: clearly the savings potential is considerable.

The first priority for improving building energy efficiency in CEE is to make those changes with the highest returns and largest savings. Although much of the building stock is in relatively poor condition, the shortage of housing means that very few residential buildings will be replaced in the near term. Therefore low-cost investments can be economically justified, even in older buildings, without concern that the building will be torn down before the investment pays off.[71] The technologies providing these high returns include, for example, thermostatic radiator valves, district heat distribution system controls, resets, and cutouts. Although the financial attractiveness of these technologies will vary depending on the specific application, in most cases they offer rapid paybacks.

As in the industrial sector, implementing these low-cost measures requires several components:

- awareness of their availability and energy savings potential;
- incentives to take the time and effort to install them;
- hardware, and the capital to buy them; and
- knowledge of how and where to use them.

Much of the discussion above on implementing low-cost measures in industry applies to the buildings sector as well. To summarize, awareness of availability and energy savings potential can be spread through professional journals, training, word-of-mouth, demonstration programs, exhibitions and trade fairs, and other informal communication channels. Providing decision makers with the correct price signals, and allowing the benefits (and costs) of efficiency to flow to those making the decisions, will provide the needed financial incentives. Building designers, builders, and owners may recognize the energy-savings potential and have a financial incentive to make the investment, and yet not have the needed capital. Several innovative financing schemes could be used to supply capital to the buildings sector for energy efficiency investments, including performnance contracting, utility financing, and payment in energy rather than in currency. Technical expertise can be provided through audits, general educational materials such as videotapes and books, technical courses, and exchange programs.

The second priority is to improve the energy efficiency of new buildings and appliances. At present there is a shortage of residential housing in much of CEE, and if the service sector grows as rapidly as predicted there will soon be a shortage of commercial buildings (for offices, stores, restaurants, and so on) as well. The financial attractiveness of retrofitting *existing* buildings with insulation, high-quality windows, and other energy efficient features is often questionable; however for *new* buildings the incremental frost cost is much lower and therefore these investments are usually profitable.

There has been rapid growth in the building energy efficiency business in recent years in the United States, due largely to utility investments in energy efficiency and to changes in State and Federal regulations. Many smaller companies are producing energy efficient devices, such as commercial lighting reflectors and high-R windows. Larger appliance companies are investing considerable R&D resources into meeting Federal energy efficiency standards. Numerous consulting and marketing companies are assisting utilities in their auditing and demand-side planning efforts. And new building design and construction firms have paid increasing attention to energy efficiency, due largely to the growing use of State building energy codes.

Transferring these technologies and practices could be aided by CEE adoption of some of the

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70 L. Schipper and R.C. Cooper, supra note 35, p. 60.

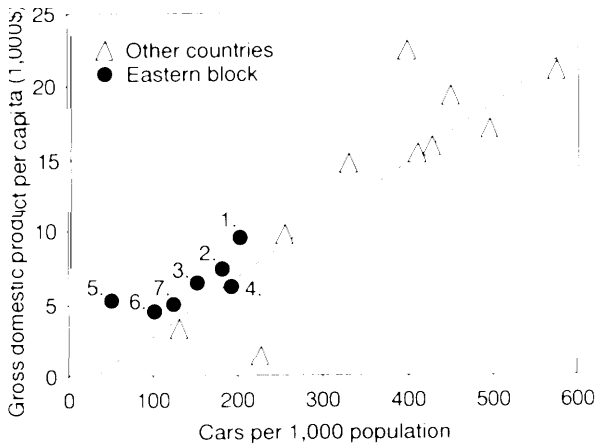
71 This is in contrast to industry, where one faces the decision of whether or not to invest in a facility that may close due to lack of demand.

same incentives used in the United States—notably utility investment combined with regulatory change. In the United States, various market issues such as high information and transaction costs, separation between owners and tenants, and high consumer discounting have led to a greater reliance on regulation in the buildings sector than in the industry or transport sectors.[72] For example, in the United States appliance standards and building codes set minimum energy efficiency levels, and recent legislation (the Energy Policy Act of 1992) increases the coverage of both codes and standards. If CEE countries were to adopt similar provisions, the affected industries would have to adopt the appropriate energy efficient technologies and practices. Russia's building code, for example, is currently being revised.[73] Communication with code revision bodies in the United States, such as the Council of American Building Officials (CABO) and the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE), could help pinpoint useful and effective technologies and practices.

TRANSPORTATION

Economic and social activities depend on movement of goods, services, and individuals from one location to another. The effectiveness of this exchange depends on the availability and efficiency of a nation's transportation network. As a nation's economy develops, its demand for raw materials, food, labor, goods and services, and personal mobility develops as well; resulting in an increased need for more extensive, reliable, and affordable transportation. These trends have been observed in Western industrialized nations and in less developed nations with growing economies. It is likely that the economies of Central and Eastern Europe will experience similar demands (figure 4-1).

Figure 4-1—Income and Vehicle Ownership



1. Former E. Germany
2. Former Czechoslovakia
3. Hungary
4. Yugoslavia
5. Former Soviet Union
6. Poland
7. Bulgaria

NOTE: Data are approximate. Line shown is for reference only.

SOURCE: *The Economist*, Mar. 10, 1990, p. 71.

Along with the increased demand for transportation services could come an increase in the amount of energy required by the transportation sector. Three elements shape transportation energy use:

- Activity—measured in passenger-miles and ton-miles;
- Modal mix—the contribution each transportation mode (such as road, rail, air, and pipeline) makes to the total transportation sector; and
- Modal energy intensities--a combination of vehicle fuel intensity (energy per vehicle-mile) and utilization of vehicle capacity (number of passengers or tons of freight per

[72] This issue is discussed in more detail in U.S. Congress, Office of Technology Assessment, *Building Energy Efficiency*, **OTA-E-518 (Washington DC: U.S. Government Printing Office, May 1992), p. 131.**

[73] RAS, Inc., "Tkchnologicat Potential of Energy Conservation in Transport and Construction Sectors of Economy of the Russian Federation" contractor report prepared for the Office of Technology Assessment, December 1992, p. 29.

Table 4-10-Transport Systems and Energy Use, 1989/1990

		Road				Rail			Air		
Country	Transport energy use as a % of Total	Road energy use as a % of Total	Length of road Network (1,000 km)	Pass.-km by road (bil)	Freight tonne-km by road (bil)	Rail energy use as a % of Total	Pass.-km by rail (bil)	Freight tonne-km by rail (bil)	Air energy use as a % of Total	Pass.-km by air (bil)	Freight tonne-km by air (bil)
former CSFR	7	3.2	75	40	13	0.8	20	66	0.4	2.6	<1
Hungary	13	10.6	30	22	8	1.6	13	20	0.7	1.6	<1
Poland	12	9.4	NA	58	9	1.8	61	111	0.7	4.9	<1
FSU	16	7.1	970	480	143	2.8	411	3,852	3.2	229.0	3.3
US	27	19.8	6,280	5,182	1,269	0.6	40	1,798	2.3	561.0	16.2
OECD Europe	27	22.2	NA	NA	NA	0.7	NA	NA	2.9	NA	NA

NOTE: Data are uncertain. NA = not available. Energy data exclude conversion losses.

SOURCES: OTA estimates, based in part on World Bank, "Greenhouse Gas Strategy for Eastern Europe and the Former Soviet Union," August 1992, draft, Appendix III, pp. 3-20; Eurostat, "Country Reports: Central and Eastern Europe 1991," Statistisches Bundesant, Luxembourg, 1991, pp. 116-125; Oak Ridge National Laboratory, "Transportation Energy Data Book: Edition 12," ORNL-6710 (Oak Ridge, TN: March 1992), pp. XXIII, 6-9; U.S. Department of Transportation, "National Transportation Strategic Planning Study," Washington, DC, March 1990, p. 10-1; International Energy Agency, *Energy Statistics and Balances of non-OECD Countries 1988-1989, OECD (Paris, 1991).*

vehicle) which yields energy use per passenger-mile or per ton-mile.[74]

To decrease the amount of energy used by the transportation sector one can work to alter each of these elements. The primary methods for achieving this goal are:

1. moderating demand by changing behavior (e.g. by changing prices so as to reflect all relevant social costs) or decreasing the need for transportation via improved urban planning and communications;
2. influencing modal mix; and
3. improving the efficiency of each transportation mode.

Implementing options 1 and 2 relies heavily on internal government policies and the establishment of appropriate market forces. Option 3, although possibly requiring the government to provide the impetus, is most dependent upon the availability and application of technology, and is therefore the major focus of this section.

The following discussion briefly examines how energy is used in the transportation sectors of the former CSFR, Hungary, Poland, and the Former Soviet Union; what potential strategies exist to improve the efficiency of transportation in these nations, and the potential role of the United States in improving the transportation energy efficiency of these nations.

Energy Use

In 1989, transportation comprised a large portion of the total energy consumed in the Western countries-nearly 27 percent in the United States, and 25 percent in former West Germany. In contrast, the FSU used only 16 percent of its energy for transportation; Hungary and Poland 13 percent, and the former CSFR only 7 percent (table 4-10). These significantly lower numbers correspond to the more limited economic development of these nations as compared to Western countries, i.e. they have lower industrial output and lower GNPs per capita which are

[74] L. Schipper and S. Meyers, "Trends in Transportation Energy Use, 1970-1988: An International Perspective," LBL-32384 (Berkeley, CA: Lawrence Berkeley Laboratory, May 1992), p. 1.

Table 4-1 1—Comparison of Auto Ownership Levels (cars/1000 **people)**

Country	1950	1960	1970	1980	1987
FSU	3	3	7	31	45
Poland	1	4	12	66	104
Hungary	1	2	10	83	157
Czechoslovakia	8	14	46	152	174
France	39	130	233	355	393
East Germany	NA	9	61	149	207
West Germany	13	82	208	375	470
U. S. A.	268	345	428	537	555

SOURCE: J. Pucher, "Capitalism, Socialism, and Urban Transportation: Policies and Travel Behavior in the East and West," ***A PA*** Journal, Summer 1990, p. 281.

directly linked to factors such as automobile ownership (table 4-1 1).

From 1980 to 1989 the centrally planned economies of Central and Eastern Europe exhibited modal shifts in transportation use. The most prominent of these shifts was the increasing reliance of each region on automobiles and trucks. These changes occurred because of shifts in industrial output and the types of goods being produced, as well as the desire of individuals for enhanced personal mobility as indicated by a general increase in the amount of passenger travel. The area of largest growth was in the use of automobiles, although passenger travel on planes generally increased as well. A shift to road transport portends that the transportation sector, if not managed effectively, will consume an increasing amount of energy and a larger fraction of each nation's total energy use.

Automobiles often are one of the fastest growing energy segments in a developing market economy. Industry analysts project that demand for automobiles in CEE will grow by 133 percent during the 1990s. This compares to an OECD rate over the same period of just 10 percent.[75]


Joanne M. Sedor

Relatively few people own cars, but the number is growing rapidly.

According to one estimate, it is predicted that Eastern Europe will account for 60 percent of all growth in the automobile industry over the next 20 years.[76]

An increase in automobile use increases demand for gasoline unless fuel economy increases faster. For example, in Poland private gasoline use rose by 17 percent from 1990 to 1991.[77] Because private use for gasoline has been historically low, new demand will require additional refining in those nations with such capability, or the expenditure of more capital for the import of gasoline. Thus, the average efficiency of automobiles in these nations, particularly newly acquired vehicles, is critical. It is estimated that if the FSU's car fleet was used under Western conditions, the energy intensity would be approximately 9 liters/100 km (26 miles per gallon [mpg]). The actual on-the-road energy intensity of cars is estimated at 11-12 liters/100 km (20-22 mpg) due to poor fuel quality, vehicle maintenance, and road conditions.[78] A recent study

75 Y. Karmokolias, "Automotive Industry Trends and Prospects for Investment in Developing Countries, " International Finance Corporation, The World Bank, 1990.

76 J, Lindquistand C. Ackerman, ' 'Moving Into Overdrive," *Director,* November 1990, p. 125.

77 S. Meyers, "Economic Reform and Energy Efficiency in Eastern Europe, " contractor report prepared for the Office of Technology Assessment, December 1992, p. 4.

78 L. Schipper and S. Meyers, supra note 74, p. 11.

Table 4-12-Comparison of Modal Splits in Urban Transportation (percent of urban trips)

Country	Auto	Public transport	Pedestrian and bicyclist	Ratio of auto to public transport
FSU	12	88	NA	0.14
Poland	15	85	NA	0.18
Hungary	11	58	31	0.19
Czechoslovakia	13	52	35	0.25
France	47	11	35	4.30
East Germany	24	27	48	0.89
West Germany	48	11	40	4.40
U. S. A.	82	3	10	27.30

NOTE: Public transport includes bus, street ear, subway, urban ferries, cable cars, inclined planes, and automated guideway systems. Dates for the data are the most recent for each of the available countries.

SOURCE: J. Pucher, "Capitalism, Socialism, and Urban Transportation: Policies and Travel Behavior in the East and West," *APA Journal,* Summer 1990, p. 282.

indicates that new models such as the VAZ-2109 and the Moskvich-2141 are designed to get 5.9 L/100 km (40 mpg) and 6.6 L/100 km (36 mpg) respectively .79 Automobiles produced in Western nations that have attributes similar to the VAZ obtain 4-4.5 L/100 km (52-59 mpg), with significantly lower pollution. Replacing the existing fleet with new automobiles getting 20 per cent better fuel economy would save about 50 million barrels of oil per year.

Public transportation systems are extensively developed by Western standards because they have prospered under direct and indirect government policies. These include fare subsidization and the existence of planned centralized housing and industrial developments. The effects of these policies are dramatic. In the United States, 82 percent of all urban trips are made with the automobile, while only 3 percent use public transportation (bus, subway, street car, commuter rail). In the FSU 88 percent of urban travel is by public transport and only 12 percent by automobile.[80] Most European nations fall between these extremes, with Central European nations being most similar to the FSU (table 4-12). Automobile travel, given as passenger kilometers per capita per day, has universally increased (table 4-13). In contrast to West Germany and the United States, the use of public transportation in CEE increased between 1980 and 1985.

In addition to the extensive availability of public transportation networks in many Central and Eastern Europe nations, the relatively low cost of public transportation makes it attractive. Table 4-14 indicates how expensive automobile use is relative to public transport.

Even automobile owners in this region usually take public transportation to work. The reasons for this behavior are the high cost of fuel, high automobile operating costs, parking problems, and frequent inexpensive public transport service during peak hours.[81]

Rail systems for freight are extensive as well, although this system currently faces decreasing utilization as industrial output declines. Coal use for rail transport has been declining over the last decade throughout the region as the use of diesel locomotives and track electrification increases.

Air transportation, particularly in the FSU where greater distances necessitate air travel, is

79 RAS, Inc., supra note 73, p. 10.

80 J. Pucher, "Capitalism, Socialism, and Urban Transportation: Policies and Travel Behavior in the East and West," *APA Journal*, Summer 1990, p. 280.

81 Ibid, p. 281.

Table 4-13--Trends in Public and Automobile Travel (passenger kilometers per capita per day)

Country	Public transport			Automobile transport		
	1970	1980	1985	1970	1980	1985
FSU	6.1	8.6	9.3	NA	NA	NA
Czechoslovakia	7.5	9.3	9.6	6.2	15,2	15,8
France	3.6	4.7	4.9	16.8	23.2	24.6
East Germany	6.5	9.0	9.1	6.3	11.2	13.2
West Germany	4.0	4.8	4.4	16.5	21.2	22.1
U. S. A.	1.0	0.9	0.8	30.7	34.9	36.1

NA - Not available.

SOURCE: J. Pucher, "Capitalism, Socialism, and Urban Transportation: Policies and Travel Behavior in the East and West," ***APA Journal,*** Summer 1960, p. 284.

well developed. The energy efficiency of the system is below Western standards, primarily because of the use of less technically advanced equipment. The former Aeroflot appeared to be energy-efficient, but only on a per passenger basis. Unlike western airlines, most Aeroflot flights were full. Generally speaking, energy requirements per seat-kilometer of the former Aeroflot fleet are 50 percent higher than those in Western nations .82

Potential Strategies for Improved Efficiency

This section briefly examines possible methods to improve the efficiency with which energy is consumed in the transportation sector, while minimizing environmental pollution and improving transport services. These objectives can be accomplished by:

1. using existing technologies to improve the individual efficiencies of each transport mode;
2. using government policies to: change modal distribution or encourage the continuing use of a more energy efficient mode—for example public buses or subways; set minimum efficiency standards for individual transport modes; and more realistically approach true costing of fuel and land use;
3. improving infrastructure and communications; and
4. promoting overall system improvements, e.g., educating individuals to provide proper vehicle maintenance.

Table 4-14-Comparison of Gasoline Prices and Public Transport Fares, 1988

Country	Ratio of gasoline price per liter to public transit fare per trip
FSU	8.2
Poland	6.8
Hungary	11.7
Czechoslovakia	9.0
France	1.0
East Germany	9.0
West Germany	0.5
U. S. A.	0.3

NOTE: Fares are the regular one-way cash fare for a typical bus or subway trip within the central city,

SOURCE: J. Pucher, "Capitalism, Socialism, and Urban Transport: Policies and Travel Behavior in the East and West." ***APA Journal,*** Summer 1990, p. 287.

Each of these methods can yield significant improvements in the energy efficiency of the transportation sector.

The task of improving efficiency in Central and Eastern Europe should be less daunting than promoting energy efficiency in less developed

82 L. Schipper and E. Martiff ot, "Energy Efficiency in Russia, Ukraine, and Belorus: Opportunities for the West,'' Lawrence Berkeley Laboratory, draft report prepared for the U.S. Department of Energy, January 1993, pp. 4-5.

nations. This region's technologically well educated population, existing transportation infrastructure, and industrialized character are all assets which augment the capacity of the region to enhance its transportation energy efficiency.

SPECIFIC TECHNOLOGIES TO IMPROVE INDIVIDUAL EFFICIENCIES

The efficiency of automobiles and trucks in CEE is lower than that of OECD nations. Table 4-15 provides a summary of commercially available technologies which could improve transportation energy efficiency. Modem automobiles usually incorporate these technologies. Technology transfer could involve integrated overall design packages or specific elements.

Technologies to improve aircraft efficiency are also available, e.g., improved airframe design, lighter weight materials, and improved jet engine design. Similarly, ships could benefit from known technologies that improve hull and engine design. Pipelines could be improved by optimization of pipe diameter and inner wall materials for the specific substances being transported, improved compressor technology, and automated leak detection.

Infrastructure, operations, and training also have the potential to save energy. Specific options include:

- improved design of roads, rails, river locks, airports, servicing facilities, filling stations, etc;
- computer controlled transport management systems where appropriate (stop light timing/ traffic control systems, train scheduling and operation, freight distribution);
- improved mechanized freight loading; and
- additional training of individuals responsible for the maintenance of various aspects of the transportation sector, e.g. those responsible for individual vehicle maintenance or traffic control.

Western companies have established several ventures that could result in rapid diffusion of applicable technologies. Examples include Pratt and Whitney commercial engine/airframe venture with Russia's Ilyushin Design Bureau; Volkswagen's investment in former Czechoslovakia's auto maker Skoda ($6 billion); Fiat's manufacturing facilities in Russia and Poland, and its sales networks in Hungary and the former CSFR; GM's efforts to initiate joint ventures in Eastern Europe; and Citibank's financing of Germany's Hochtief to renovate Poland's Warsaw Okecie Airport ($200 million).

Table 4-15-Selected Technologies To Improve Transportation Energy Efficiency

Automobile Specific
•Electronic control of spark timing
•Throttle body and multipoint fuel injection
•Improved vehicle drive trains and transmissions
•Accessory improvements
. Overhead cam engines as opposed to push-rod engines
Truck and Bus Specific
•Improved fuel injection pumps
•Electronic engine controls
•Cab mounted front air deflectors
. Turbochargers
For Autos, Trucks, and Buses
•Improved tire design
•Weight reduction
•Reduced aerodynamic drag
•Reduced engine friction
•Improved fuels
Rall Specific
•Diesel- electric locomotives
•Weight reduction
. Low friction bearing technology
•Computer directed operations
•Improved load factors
•Improved railway junctions
•Flange lubricators
•Mechanized/automated yards

SOURCE: Office of Technology Assessment, 1993.

THE ROLE OF CEE GOVERNMENT POLICIES

The actual diffusion of technologies to improve efficiency will most likely result from increased international business. Thus it is the responsibility of the host nation to provide an environment that is conducive to private international enterprise and yet synergistic with regard to its domestic agenda. This includes providing a stable government, lowering trade barriers, establishing a reliable banking infrastructure, establishing a

legal system that can provide foreign companies recourse and intellectual property protection, examining its rules regarding the repatriation of profits, and limiting restrictive technology import policies such as tariffs, quantitative restrictions, and licensing of imported technologies. It is essential that a nation's efforts be reflected in both law and in implementation of that law.

A host nation can also improve the efficiency of its transportation sector by implementing policies that encourage and reward energy efficient technologies and behavior. This might include policies that encourage:

- Land-use planning to better match residences with jobs, schools, shopping, and transport corridors.
- Truer pricing of fuel.
- Fuel efficiency standards for automobiles (similar to U.S. CAFE standards).
- Pricing of transport services to optimize modal distribution (and reflect land costs, road costs, parking, pollution, etc.).
- Retiring automobiles that are past their designed service life, (By one estimate 30 to 40 percent of the motor vehicle fleet in Russia qualifies as past its prime. Replacement of these vehicles with newer designed automobiles could save 10 to 15 percent of the fuel consumed by road transport.[83])
- Targeted research and development to improve the efficiency of the transportation sector.
- Assistance to domestic manufacturers to improve the design and manufacture of more energy efficient vehicles.

The Role of the United States

Opportunities to improve energy efficiency within the transportation sector include many that can be accomplished with commercially available technologies used widely in other industrialized nations. The rapid diffusion of these technologies could yield significant energy savings. It is quite likely that the most cost effective and rapid improvements in energy efficiency will result from the transfer of commercially available technologies.

The U.S. Government can assist in the transfer of specific technologies in numerous ways, most of which require expending capital either through direct assistance or loans. These include:

1. Providing funds to foreign nations to purchase/import specific equipment, such as automobiles, that will improve efficiency directly. This will result in immediate efficiency gains, but does not address the needs of a host nation to improve its domestic skills/manufacturing. It will however improve U.S. exports.
2. Providing funds to domestic corporations for overseas investment. These funds could be used to target foreign companies that would be appropriate recipients for energy efficient technologies. Possibilities include whole or partial ownership, joint ventures, licensing agreements where a specific technology or service is leased, or franchise agreements.
3. Providing funds for improvements in infrastructure that would contribute to more energy efficient transport services. Capital or specific technologies to improve roads, airports, railroad tracks and crossings, river locks etc. are all needed. Moneys targeted for the procurement of traffic management systems for road and air travel would also improve efficiency.
4. Providing funds for improvements in communication networks, which can alleviate the actual need for some transportation. Additionally, a better communication network would allow for improved logistics such as full loading, better routing, etc.

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[83] RAS, he., supra note 73, p. 11.

5. Providing funds for education and training, e.g., in the area of vehicle maintenance, would also contribute to more efficient transport services. Another area to target might be airport and rail operations. Specific training facilities could be set-up in host nations, within existing corporations in host nations, or through worker/student training in this country.
6. Scrutinizing domestic technology export controls, originally implemented because of strategic reasons, to allow for technology transfer.
7. Assisting with the development of foreign regulatory and government policies such as taxes, duties, true costing, and land use in urban areas to help promote those modes of travel which are the most efficient. The U.S. could provide direct government to government assistance in formulating legislation and in drafting and implementing regulations. This might be accomplished via the exchange of policy makers.

As with any effort to transfer technology, questions regarding applicability and sustainability need to be addressed. Market based industrial technology in the West has developed in a context where consumer behavior/demand and pricing schemes are unique. Higher wages and larger disposable incomes, as well as ideas of property ownership, have shaped technological development. Some high quality or high performance technologies that make sense in the West might not be appropriate for developing economies with limited capital.

Once the market has identified and implemented applicable technologies, it is important that the government continue to maintain an environment where energy efficiency is desirable via regulation and incentive based policies. An understanding of human behavior is also essential. Identifying what motivates or inhibits consumers, e.g., financial benefits, access to previously unavailable services, or discount rates, is needed as well. It also includes understanding what motivates or inhibits a company manager to use a specific technology made available as a result of a government energy efficiency program rather than to sell the technology on the market and use the proceeds for another need.

SUMMARY AND CONCLUSIONS

In the short term, there are numerous highly profitable opportunities for efficiency improvements through low-cost retrofits of existing facilities. Examples include thermostatic radiator valves for buildings, insulation and steam traps for industrial steam systems, and basic electronic controls for district heat distribution systems. In many cases these technologies offer paybacks of 1 year or less (that is, a return on investment in excess of 100 percent). Implementing these technologies requires four components: 1) awareness of their availability and energy savings potential, 2) incentives to take the time and effort to install them, 3) hardware or the capital to buy them, and 4) knowledge of how and where to use them.

There are numerous policy options that can encourage greater use of these technologies. Trade fairs, audits, and exchange programs can build awareness and technical knowledge, and various innovative financing programs (such as risk reduction and insurance programs) can encourage private sector provision of capital and hardware. As the financial returns are relatively high for these technologies, government support and encouragement of private sector efforts, rather than direct government assistance, may be appropriate. This also has the advantage of helping to build domestic capability for producing and utilizing these technologies, and avoids longer term dependence on foreign assistance.

Consideration of capital-intensive retrofits, or investment in new facilities, is more complex. These new facilities-industrial plants, buildings, appliances, automobiles, and so on—will in the long term determine energy efficiency. Most energy-using devices (such as cars and refrigera-

tors) currently being produced in CEE are much less efficient than those presently being produced in the United States. The U.S. units, in turn, are much less efficient than is technically feasible. Clearly there are technical opportunities for improved efficiency.

Implementing these new technologies requires careful consideration of the long-term economic health of the sector, especially in the industrial sector. There are some likely trends, however, that can guide future investment. There will probably be growth in the service sector, which will require more stores, restaurants, and offices. Increasing consumer incomes will lead to increased demand for private automobiles, consumer appliances, and single-family housing. Some argue that the present system has excess capacity for heavy industry such as steel and ship-building, [84] suggesting that these industries will shrink.

Two key points should be considered when contemplating policy options to promote longer term investments in energy efficiency. First, investments in new industrial facilities and buildings will depend on expectations of future demand, availability of capital, and the overall economic climate; and not on energy considerations. Energy is typically a small fraction of total operating costs in both industry and buildings, and therefore is usually not a primary consideration when making investment decisions. Nevertheless, new equipment usually is more energy efficient than old equipment, especially in industry. The policy relevance is that efficiency will be well served by overall economic development. The second and related point is that U.S. experiences show that energy efficiency often lags what appears to be economically justified due to a separation between buyers and operators, environmental externalities, information and transaction costs, and other reasons.[85] That is, market forces and economic development alone will not lead to optimal levels of energy efficiency, and policy intervention may be needed.

84 See for example J. Sachs, "Building a Market Economy in Poland," *Scientific American, March* 1992.

85 For a discussion of these issues in the buildings sector see U.S. Congress, Office of Technology Assessment, Building *Energy Efficiency*, OTA-E-518 (Washington, DC: U.S. Government Printing Office, May 1992).

Appendix 4-1
Case Studies

OTA conducted several case studies of U.S. businesses that have tried to transfer energy efficient technologies to CEE. These case studies illustrate the problems businesses face when working in CEE, and provide some evidence of the effectiveness of Federal programs to assist U.S. businesses. The case studies are:

. A medium-size privately held U.S. company's efforts to export steam traps, devices to improve the efficiency of steam systems, to Bulgaria.

. A U.S. home-building firm's efforts to build single-family housing in St. Petersburg—the first such housing to be built in 70 years.

. A small U.S. company's efforts to set up a joint venture with a Slovakian firm to manufacture and market energy efficient devices for industry.

• A large U.S.-based multinational's efforts to retrofit district heating systems in Moscow.

Case Study 1

Export of Steam Traps to Bulgaria

INTRODUCTION

A steam trap removes condensate, air, and carbon dioxide from steam systems, thereby helping to ensure high efficiency. Although steam systems are typically installed with steam traps, poorly designed traps often fail prematurely, leading to expensive steam leaks. Replacing a worn or defective trap with a high-quality trap often results in significant energy savings with rapid payback periods. Armstrong International, a U.S.-based manufacturer of equipment for industrial and commercial users of steam, manufactures and markets a complete line of steam traps, including the energy efficient inverted bucket steam trap. Armstrong is currently marketing its steam traps in Bulgaria and is working to expand its sales network throughout Central and Eastern Europe (CEE).

HISTORY OF INVOLVEMENT

Armstrong first became exposed to business opportunities in CEE through an unplanned encounter with the USAID Emergency Energy Program. An AID consultant doing energy audits in CEE contacted Armstrong for educational materials on steam energy conservation to provide to Bulgarian industrialists. AID ordered several educational videotapes from Armstrong, and within a few months ordered **90** inverted bucket steam traps. This equipment order, which specified shipment to addresses in Bulgaria and Poland, piqued the interest of Armstrong sales representatives.

Douglas Bless, Armstrong's Vice President for Sales, then arranged a visit to Bulgaria to look for a sales representative. Bless contracted with Christian Spassov, a scientist at the University of Sofia who had done energy audits for AID, to market Armstrong steam traps in Bulgaria. Within a short time Spassov sold $200,000 worth of steam traps, bought a truck and hired installers, and enjoyed steadily increasing sales.

MARKETING ARRANGEMENTS

Armstrong uses the same approach with Spassov as with their U.S. distributors. They sell him steam traps at the wholesale price and he resells them at the retail price, retaining the price difference as profit. Armstrong receives payment from Spassov in U.S. dollars and has not had to compromise its margins. While recognizing the importance of Spassov's entrepreneurial and technical skills, Bless attributes the strong sales performance of his company's steam traps in Bulgaria to their combination of low initial cost (approx. $120) and high energy savings. He estimates that, at prevailing world energy prices, the initial investment in their steam traps can be recouped within 3 to 4 months.

NEXT STEPS

Bless is currently seeking representatives in other countries in the region, hoping to find others like Spassov, with the combination of technical compe-

tence and entrepreneurial abilities needed to market and service Armstrong's products. The company is currently in the process of sifting through correspondence from numerous companies in CEE that have been exposed to Armstrong's products through the USAID program and want to represent these products in their countries. These potential distributors cite strong demand for Armstrongs products. Bless explains: "If you get to the right people in management at these companies, they understand the importance of energy efficiency, and our product, a quality steam trap, is just unavailable to them right now in their region.

KEY ISSUES: FINANCING AND STANDARDS

While Armstrong has enjoyed encouraging sales of its steam traps based on their rapid payback, it finds that many potential customers want the product but need help in financing the purchase. This situation became apparent during meetings in Hungary and Bulgaria, where local managers explained that they understood the financial gains they could achieve by investing in energy saving equipment, but simply did not have enough up-front cash to buy the equipment. Armstrong is currently exploring arrangements in which a bank purchases the equipment and has it installed, and then the plant pays the bank, over time, from the cash made available through the energy savings.

Another concern facing Armstrong is competition from West European, particularly German, companies that have been aggressively marketing similar products in the region. The situation is complicated by the fact that German firms use a different system of engineering measurements and standards than do American companies. If American companies were required to convert to the German standards system, they would have to modify their designs, adding significantly to the cost of their products and making them less competitive. For this reason, Bless stresses the importance of early market presence on the part of U.S. companies to promote the adoption of U.S. engineering standards and to create a preference for American equipment. Aside from the standards issue, Bless senses a preference in the region for doing business with American firms, particularly those associated with U.S. Government-sponsored programs, based on admiration for the U.S. Government.

ROLE OF GOVERNMENT PROGRAMS

Bless stresses the role of the AID program in getting Armstrong involved in the CEE market:

> We had been thinking that someday this is going to be a great market. USAID as a true catalyst launch[ed] this program. . .we have sold $200,000 worth of equipment and are now fully engaged in the whole region due to this success. . .we are on our way now. I think that other U.S. manufacturers can benefit from this program.

Case Study 2

Export of Prefabricated Housing and Related Technology to Russia

INTRODUCTION

Ryland Building Systems, a U.S. manufacturer of prefabricated housing units, is in the process of transferring improved building technologies to Russia. These technologies, such as insulation utilizing advanced materials; caulking and weatherstripping techniques to minimize heat losses; and the use of multiple-pane, low emissivity windows; are being transferred through modernization of a house fabrication facility in Siberia and through a joint venture with a Russian contractor to build a housing development in St. Petersburg.

INITIAL INVOLVEMENT: FACTORY MODERNIZATION

Ryland first became exposed to the Russian housing industry in 1990, when it was invited to look at a housing factory in Western Siberia. After visiting the factory, Ed Grachik of Ryland observed:

> The [existing] equipment was of Swedish origin, about 10 years old, and the problem was that they had not maintained it. In most cases they had bought maybe two pieces of a given type of equipment, and only one was running because they had taken parts off of one to keep the other ruining. The equipment was rather sophisticated, in our minds too sophisticated for what they were trying to do.

Ryland has made plans to set up a new factory, provide training, and then turn the factory over to the Russians. They have, however, been unable to implement their plans due to the Siberian company's inability to obtain the needed hard currency, The project has been put before the Russian government, which has so far been unwilling to authorize the expenditure of hard currency needed to finance the project,

CURRENT PROJECT: BUILDING HOUSES IN ST. PETERSBURG

While working on the Siberian project, Ryland came in contact with a Russian group involved in fabricating precast concrete building components and providing civil engineering services to the construction industry in St. Petersburg (formerly Leningrad). Ryland joined with this group to form a joint venture, called Ryland St. Petersburg, to build houses in St. Petersburg. The venture has obtained a building site on which it plans to build 23 townhouses of approximately 2,000 square ft. each, with a basement and garage at ground level and two floors of living space. Approximately 80 to 90 percent of the materials and prefabricated components will be shipped from the United States. The windows and some other components are being sourced from Finland, and a small amount of local materials will be used, such as stucco for the exteriors, The foundation

work has already begun, and Ryland hopes to have the models open in the Spring of 1993.

MARKETING PLANS

Ryland plans to market the townhouses to Western companies that have established offices in the area and to the small number of Russians who have the hard currency to buy them. Recognizing that the majority of the local population will not be able to afford houses made of materials exported from the United States, Ryland views the current phase of the venture as a training period and is working toward incorporating local materials, identifying local contractors, and establishing incountry manufacturing facilities.

DIFFERENCES IN TECHNOLOGY

Differences in construction materials and technology have led to concerns about the thermal performance of the houses. The Russians, accustomed to masonry walls 12-16 inches in thickness, have reacted with skepticism when confronted with a 5-inch thick frame wall of equal insulation value. "The first reaction is 'that's no good, ' and we try to explain to them that it is better, " says Grachik, who has also expended considerable effort educating Russians on the importance of minimizing air leakage through windows and doors. The houses exported by Ryland will incorporate triple-pane windows from Finland and other design features to improve the air-tightness of the house. Ryland expects energy efficiency, along with overall construction quality, to be a major selling point for its houses.

COMPLICATIONS

Ryland has experienced difficulty in getting its designs approved by local inspectors, due in part to unfamiliar materials and construction techniques. The process is further complicated by the fact that these townhouses will be the frost private houses to be built in St, Petersburg in 70 years. Ryland, with the help of its venture partner, has managed to convince Russian authorities of the soundness of its designs by demonstrating adherence to U.S. and international standards.

Ryland's plans have also been complicated by land ownership considerations. Most land is still government owned and clear mechanisms for private ownership have yet to be established. The venture has negotiated a 99-year lease from the city for the current project, and is doing the same for a second joint venture in Moscow. Another problem is the absence of mortgage financing, which will likely put house purchases out of the reach of the general population.

ROLE OF GOVERNMENT PROGRAMS: TRADE DEVELOPMENT PROGRAM

Ryland has received a grant from the Trade and Development Program (TDP) to conduct a study on issues relevant to the development of the Russian housing market. The study includes development of a survey **to** determine what design parameters Russian people look for in a house. The TDP study will also help Ryland identify local materials and evaluate the feasibility of manufacturing in the country.

CONCLUSIONS

Grachik acknowledges the difficulties inherent in doing business in Russia, but believes that Ryland's current efforts have potential to pay off:

> Every day, it seems there is a different problem, but as a company we feel there is an opportunity there in the future. That's why we are spending our time, investing, doing things in anticipation that things will be more stable, and once that occurs there will be a large market for housing there. But in order to participate in that, you are going to need to have incountry manufacturing and construction capabilities, and that is what we are trying to develop right now.

Case Study 3

Joint Venture to Manufacture Industrial Energy Devices in Slovakia

INTRODUCTION

The *phase liner* reduces energy losses in electric motors by aligning the phase angle of current and voltage in the motor. The flue ***gas*** *controller* improves furnace, boiler, and water heater efficiency by reducing excess stack draft. Vertech International, a small U.S. company, is transferring these patented technologies to a manufacturing company in Bratislava, Slovakia and plans to market the devices throughout Eastern Europe and the former Soviet Union.

HISTORY OF INVOLVEMENT

In 1990 one of the principals in Vertech, Peg Kay, hired an agent to look for business opportunities in Central and Eastern Europe (CEE). The agent subsequently visited Elektroakustika, a manufacturer of audio equipment in Bratislava, which expressed interest in bringing in new technologies from the West. He relayed this information to Kay, and also reported that energy consumption was a major concern in the region, due to recent fuel price increases and environmental problems.

Vertech determined that the phase liner would be an appropriate device for Elektroakustika to manufacture. Vertech began negotiations with the U.S. patent holder for a licensing agreement covering manufacturing and distribution rights in Central and Eastern Europe (CEE). Vertech is now working out a joint venture agreement with Elektroakustika for the manufacture and distribution of energy saving products.

Vertech is also negotiating with the inventor of the flue gas controller, and is planning to submit a funding proposal to the Czech and Slovak American Enterprise Fund.

MARKETING PLANS

Vertech is currently working through incountry contacts to sell the products through their energy savings, using a concept called performance contracting. This concept enables the customer to finance the purchase of energy efficient products through future energy savings. An outside company arranges the financing, acquires and installs the equipment, and guarantees that future savings will cover any debt incurred by the customer. In effect, performance contracting accesses money that would otherwise go to the energy supplier, involves no up-front investment by the customer, and gives the vendor a chance to demonstrate the effectiveness of the product and services.

The Slovakian venture partner has also marketed the products to the Slovak Power Enterprise which has indicated a willingness to assist in marketing and possibly financial support.

KEY ISSUES: FINANCIAL REGULATIONS, BUSINESS SERVICES, AND ECONOMIC AND POLITICAL STABILITY

Financial regulations regarding foreign ventures at first appeared to be a problem, as there was a 55% tax on gross profits and a requirement for 30% government ownership in any company with foreign involvement. The ownership requirements have since been relaxed and foreign companies are now subject to the same tax treatment as domestic ones. In addition, in an effort to attract foreign investment, a tax holiday has been declared for foreign companies. Vertech has been assured by government authorities that currency conversion will not present a problem.

Vertech has been inconvenienced by the absence of a developed business service infrastructure in the region. Only one U.S. law firm has operations in Slovakia, and it serves mainly large businesses. Bookkeeping is complicated by the continued use of communist accounting systems and unfamiliarity with Western accounting practices. Banking services are limited, with check cashing often requiring up to 6 weeks.

In view of the division of Czechoslovakia, there is some concern over economic and political stability, notably potential economic conflict between the Czech and Slovak republics and potential ethnic unrest involving Slovakia and Hungary. Vertech views economic growth in the region as the key to avoiding such conflicts and believes that problems are likely to materialize only if the economies stagnate.

ROLE OF GOVERNMENT PROGRAMS

The venture has received much assistance from representatives of the Slovak embassy. A former principal in Vertech, Shirley Hansen, also reports having received valuable information and support from the Czech and Slovak-American Council of the U.S. Chamber of Commerce.

The group has also worked with SEVEn in Prague, one of three Energy Efficiency Centers set up to support energy efficiency related ventures in Eastern Europe, for assistance in marketing its products to utilities. SEVEn has been helpful in working with utilities and in explaining the merits of performance contracting to potential users.

Kay gives the Commerce Department's International Trade Administration much credit for being responsive and helpful in supplying information and statistics. She also feels that AID 'is doing shockingly good, but thinks their programs should focus more on small businesses and include Czechs and Slovaks in their meetings, claiming that they "would love to sit down with AID. " Kay explains, "culture clash problems exist when large companies try to establish a presence in Eastern Europe. Small companies give places like Slovakia a chance to grow their own manufacturing. '

The group's outlook is summed up by Hansen: "I think there is a lot of opportunity for U.S. companies to do a lot of good over there. "

Case Study 4

Improving the District Heating System in Moscow

INTRODUCTION

A *Fortichka is* a little window built within the frame of the surrounding larger window, and is used to regulate room temperature in a Russian apartment-if the apartment gets too hot, *the fortichka* is opened and the excess heat escapes. Honeywell Inc., manufacturers of home, building, and industrial controls, in cooperation with the Moscow City Council and a Russian-Honeywell joint venture, is working to find more cost-effective ways to regulate building temperature than by opening a window.

PROJECT DESCRIPTION

In the Tushino district of Moscow, Honeywell has initiated a retrofit of the region's district heating system. (Throughout Central and Eastern Europe (CEE), district heating is the predominate system in most urban areas. Most of these systems lack modem thermostat or boiler controls.) Honeywell estimates that installing modem boiler controls in the Tushino district alone, which consists of 350 buildings and over 20,000 apartments heated by four natural gas boiler plants, will result in natural gas savings of about 20 percent (this number is approximate, since total gas consumption in the Tushino District was not previously monitored). Installation of boiler controls represents the first stage in Honeywell's initiative. In the second stage, Honeywell will oversee the installation of a heat exchanger control system to capture and reclaim waste heat from combustion gases and other sources. With both control systems in place, there should be a 30 percent reduction in natural gas consumption. The final step in the pilot program outlined by Honeywell is to equip each individual flat with thermostats and meters so that tenants can control and be billed for their individual consumption. If all three stages were implemented, the resulting energy savings could be as high as 45 percent.

The combined cost for the first two stages in the Honeywell plan is an estimated $3 million. The three partners-Honeywell, the Moscow City Council, and Agrochem-have each agreed to donate $1 million for the project. In Honeywell's view, a major retrofit of the district heating systems in the former Soviet Union would result in enormous energy savings, and the potential revenues from the increased export of natural gas and other energy resources resulting from more efficient domestic use could go a long way toward fueling the process of structural change currently underway, In the Tushino District alone, one of 55 districts in Moscow, a 30 percent energy savings translates into about $2 million/year of natural gas saved (or available for export). There are about 1,000 such district heating systems in the FSU. The potential market and energy savings from gains in energy efficiency are enormous.

FINANCIAL ARRANGEMENTS

Honeywell is not a stranger to the Russian market. In 1988, representatives of the Fertilizer Ministry came to Honeywell with the idea of installing Honeywell's process controls in their fertilizer plants, which export their product for hard currency. A joint venture, *Sterch.* was formed and has completed retrofits on 22 fertilizer factories.

In retrofitting the district heating systems in the FSU, financial arrangements could be made in terms of the product saved--energy. Natural gas, for example, could be exported as payment for installation of management and control devices. Such a barter arrangement is difficult for an individual corporation to arrange; however, with the mediation of international lending organizations and government agencies, such large scale agreements can be an attractive option for capital-constrained CEE industries.

Programs To Assist Energy Efficiency

5

The political and economic transition in Central and Eastern Europe (CEE) has been accompanied by a proliferation of international activity aimed at ameliorating the region's energy and environmental problems. One United Nation report cited 14 multilateral organizations and initiatives supporting energy programs, and the United States, the European Community (EC), and several other Western countries have bilateral energy assistance programs.[1] The objectives of these energy programs are diverse and vary by recipient country. The emphasis overall has been on energy price reform, restructuring the energy sectors, and the rehabilitation and modernization of energy supply infrastructure. Much less has been done on the demand side, on end-use energy efficiency projects, or promotion of integrated resource planning and other planning techniques that support energy efficiency.

However, the human resource and institutional capacity for increasing the scope of energy efficiency programs is getting more developed each year, supported at relatively low cost by U.S. and European programs. Multilateral donors are indicating that greater resources will be available for energy efficiency, partly in support of initiatives to reduce emissions of greenhouse gases, but also in recognition of the major gap between projected needs for energy investment in Central and Eastern Europe and the limited availability of financing over the mid term. As energy prices continue to rise, regulatory frameworks become more established, and economies grow, the demand for energy efficiency technologies and services will increase, perhaps dramatically. The United States has substantial resources,



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[1] U.N. Economic and Social Council, Economic Commission for Europe, ***Multilateral Assistance to Economies in Transition in the Field of Energy: A Preliminary Overview and Evaluation,*** Aug. 28, 1992, p. 9.

ranging from export promotion and financing to research and development (R&D), that could be mobilized more effectively and productively to support the transfer of energy efficiency technologies and services on commercial and noncommercial terms.

This chapter describes the energy efficiency aspects of U.S. and other energy assistance programs in Central and Eastern Europe. But frst, the chapter provides an overview of energy assistance efforts and trade and investment opportunities.

THE ENERGY ASSISTANCE EFFORTS

There have been several transitions in the Western energy assistance effort during the relatively brief period that it has been underway. In the first year, circa late 1989-90, energy assistance was largely ad hoc while Western governments and multilateral organizations struggled to research the East's energy systems and prescribe anew energy policy framework organized around market principles. The first major step in this process was energy price increases and plans for energy sector restructuring and privatization in Poland, and later Hungary and the Czech and Slovak Republics, as conditions for World Bank structural adjustment loans. Bilateral assistance at this point was fragmentary. Indeed, energy was initially subsumed under the environment, which had captured world attention and was more of a priority for the Western assistance effort. The first U.S. energy project focused on installing scrubbers on a powerplant in Krakow, Poland, and the EC did not begin developing a distinct energy program until 1991.

In 1990-91, attention was galvanized by the economic impact on Central Europe of rising oil and gas prices and shortages as the Soviet Union raised the prices of its energy exports and then failed to make deliveries and as energy markets responded to the Persian Gulf crisis. This prompted some rapid emergency energy initiatives by the United States and the EC, which included end-use energy efficiency as one of the short-term means for ameliorating the problem.

Since 1991, there has been an expansion in energy assistance in Central Europe and the Baltics by the World Bank, the European Bank for Reconstruction and Development (EBRD), and other bilateral donors. Energy assistance has focused on the rehabilitation and modernization of energy supply infrastructure, primarily in the power sector and in district heating, natural gas, and energy efficiency. In 1992, Russia and the other newly independent states (MS) have also begun to receive energy assistance focused on reviving oil and gas production and nuclear power safety. Also, there has been a sustained effort to create a Europe-wide (West and East) binding legal and regulatory framework for energy, the European Energy Charter, that is likely to be substantially completed in 1993.

Western donors have funded many types of energy projects on varying scales. The World Bank and other multilateral donors have financed over $1 billion in large energy-sector projects.[2] Bilateral donors with more limited resources, including the United States and the EC, provide technical assistance, training, and limited equipment. While the scope of the bilateral programs is difficult to ascertain, they probably total between $150 and $200 million.[3]

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[2] Joerg-Uwe Richter, "Energy Issues in Central and Eastern Europe: Considerations for International Financial Institutions," *Energy Journal, vol. 13, No. 3, 1992;* and Bernard Montfort and Harold E. Wachman, "The World Bank Support for Energy Sector Transformation in Central and Eastern Europe," (World Bank, July 1992).

[3] As discussed below, U.S. energy assistance is about $100 million over 19! 0-94; European Community energy assistance is estimated at $41.5 million over 199092. With no verification, up to another $50 million is assumed for bilateral European and Japanese energy assistance. See U.N. Economic and Social Council Commission for Europe, *Multilateral Assistance to Economies in Transition in the Field of Energy: A Preliminary Overview and Evaluation,* Aug. 28, 1992.

devoted around $15 to $20 million[4] to support demand-side energy efficiency, through energy policy and pricing reform, management training, and joint venture promotion.

TRADE AND INVESTMENT OPPORTUNITIES

As described in previous chapters, there are immense opportunities for energy efficiency in Central and Eastern Europe. One estimate of the potential market for energy efficient industrial products is $20 billion and estimates of the cost of energy sector modernization, primarily in the power sector, generally run into the hundreds of billions of dollars over the coming years.[5]

Despite several programs that support trade and investment in the region, the United States is not currently well positioned to do business in the energy efficiency area. The power sector has attracted a number of U.S. firms, such as Westinghouse and Bechtel. General Electric and Honeywell also have investments and operations in the region as do several energy and environmental consulting firms, such as Booz-Allen Hamilton and Coopers & Lybrand. Also, equipment purchases from U.S. firms under U.S. energy assistance projects have stimulated some follow-on business activity. However, there are major barriers to increased exports of U.S. energy efficiency technologies and services to Central and Eastern Europe. The U.S. energy efficiency industry, composed largely of small and medium-sized fins, is only now mobilizing to export. Central and Eastern Europe lacks capital, is a distant market, and presents persistent economic and political uncertainties--even to large fins. On the positive side, Central and Eastern European countries are very receptive to U.S. businesses and desirous of U.S. technologies. Moreover, there are strong cultural and ethnic linkages between the United States and Central and Eastern Europe.

The U.S. Government does have several programs for export and investment promotion, financing, and insurance that support firms doing business in the region. Some of these programs are targeted at smaller firms, but the energy efficiency industry has not heretofore been supported in this fashion. Also, U.S. export assistance programs have generally not been particularly accessible to, or perhaps well understood by, smaller firms. There have also been concerns that U.S. financing programs do not have adequate resources, nor provide sufficient long-term financing and insurance to support effectively U.S. firms exporting capital goods and energy services to Central and Eastern Europe.[6] There is a U.S. Department of Energy (DOE) program under consideration—the Committee for Energy Efficiency, Commerce and Trade (COEECT)-as well as several nongovernmental organizations that could assist in creating a more coherent export strategy for the U.S. energy efficiency industry.

By far the largest sources of public financing for energy projects and investments are the multilateral and regional development banks—the World Bank Group and the EBRD. These banks have coremitted about 10 times as much to energy projects in the region as has the United States, but primarily to energy supply infrastructure. The Global Environment Facility (GEF) is another multilateral source of financing that will

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[5] The estimate for industrial energy efficiency is from Alliance to Save Energy, *Business Opportunities in Eastern Europe for Energy -Efficient Industrial Products*, (Washington, DC: Alliance to Save Energy, January 1992). Investment requirements for energy sector rehabilitation could run as high as $120 to $150 billion over 1991 to 2000, according to Joerg-Uwe Richter, ' 'Energy Issues in Central and Eastern Europe: Considerations for International Financial Institutions, ' *The Energy Journal*, vol. 13, No. 3, p. 270.

[6] It should be noted that U.S. export assistance programs are less supportive of smaller firms and have less resources than do those of many European countries and Japan. European firms also have the advantage of proximity to Central and Eastern Europe.

[7] An annual report to Congress under the SEED Act, compiled by the Department of State, provides an inventory of the U.S. and multilateral programs. See Department of State, *Report on FY 1990 Actions Mandated Under the SEED Act of 1989* (January 1991); Department of State, *SEED Act Implementation Report, Fiscal Year 1991* (Jan. *31, 1992).*

Box 5-A-Legislation and Funding for U.S. Assistance to Central and Eastern Europe

U.S. **assistance to Central and Eastern Europe is mandated under two major pieces of framework legislation, the Support for East European Democracy (SEED) Act of 1969 (PL 101-179),** and the Freedom for Russia and Emerging Eurasian Democracies and Open Markets (FREEDOM) Support Act of 1992 (PL 102-51 1). Funds for the assistance effort have also been appropriated under other foreign aid bills as well as reprogrammed by some agencies.

The SEED Act was passed by the Congress and approved by the Administration in November 1969, and authorized $930 million for fiscal years 1990-92. Foreign aid appropriations for fiscal year 1990 included $659 million for Poland and Hungary. Amid much debate over the appropriate scope of U.S. assistance, Congress provided about $370 million in assistance for fiscal year 1991, along with $70 million for the newly forming European Bank for Reconstruction and Development (EBRD) and $3 million for Romania. In September 1991, Congress reprogrammed $11 **million in aid to start SEED** programs in the Baltic% Congress failed to authorize fiscal year 1992 foreign aid, and funding was appropriated under a Continuing Resolution which made $370 million available **for the entire** region. **The Foreign Appropriations Act of 1993 (PL 102-391), signed on Oct. 6, 1992, provides $400 million in assistance in fiscal year 1993 for Central Europe and the Baltics.**

Assistance to the Newly Independent States (NIS), and in particular to Russia began in 1990 with the extension of credits for imports of U.S. agricultural commodities followed by pledges of additional aid and the use of Defense Department appropriations for destruction of weapons and other uses. About $460 million was appropriated up to mid-1992 for humanitarian and technical assistance. An additional $417 million was appropriated for the NIS in the Foreign Appropriations Act of 1993.

In April 1992, the Bush Administration proposed the FREEDOM Support Act, framework legislation that defines the U.S. policy toward the NIS, provides authority for assistance programs, and proposes a number of trade measures (other provisions of the FREEDOM Support Act, such as new financing for the International Monetary Fund, have been approved under the foreign appropriations bill). The Senate cleared the FREEDOM Support Act with modifications in June 1992 and the House in October 1992. The Act authorizes $410 million in assistance to the NIS.

SOURCES: Congressional Research Service, selected briefs; Congressional Quarterly.

ture. The Global Environment Facility (GEF) is another multilateral source of financing that will increasingly fund environmentally sound energy projects, including energy efficiency.

U.S. PROGRAMS

| Legislative and Policy Framework and Objectives

U.S. Government activities in Central and Eastern Europe are authorized under the Support for East European Democracy (SEED) Act of 1989 and the Freedom for Russia and Emerging Eurasian Democracies and Open Markets (FREEDOM) Support Act of 1992. (See box 5-A.) A number of government agencies have also undertaken activities in the region using appropriations from their own budgets.[7] Assistance has been predicated on progress toward political pluralism, economic reform, human rights, and improvement in relations with the United States.*

[7] An annual report to Congress under the SEED **Act,** compiled by the Department of State, provides an inventory of the U.S. and multilateral programs. See Department of State, *Report on FY 1990 Actions Mandated Under the SEED Act of 1989* (January 1991); Department of State, *SEED* Act *Implementation Report, Fiscal Year 1991* (Jan. 31, 1992).

[8] Under the SEED Act, Poland and Hungary were eligible for assistance in fiscal year 1990, and Albania, **Bulgaria, CSFR, Estonia, Latvia, Lithuania,** Romania, and Yugoslavia in **fiscal** year 1991.

Parallel to the assistance effort, the United States has been negotiating agreements to enhance trade and investment. The countries in the region are eligible for the General System of Preferences (GSP) and Most Favored Nation (MFN) status. There are also a number of bilateral treaties that protect U.S. companies that export or invest in the region, providing protection for intellectual property rights, transfer of profits, security of investments, legal rights, and in some cases liability.

The SEED Act programs were initially organized as what the General Accounting Office (GAO) has characterized as a "short-term experimental economic assistance approach' based on three primary assumptions: assistance would only be required for a 5-year transition period; allocation of funding would take place on a regional, rather than country-specific basis; and the programs would be managed centrally in Washington with limited authority granted to in-country personnel.[9] This reflected a U.S. decision that the assistance programs were not the beginning of a long-term traditional aid program. The regional approach was adopted in theory to allow for program flexibility and responsiveness as the political situation changed in the region, and also to limit the Agency for International Development (AID) contracting requirements given the many actors and projects involved. [10] However, the GAO, which conducted its evaluation in 1991 and early 1992, found that these characteristics had hampered the assistance effort in some ways. The regional approach made it difficult for assistance recipients to plan and prioritize proposals, and recipients sometimes did not feel that aid was tailored to each country appropriately. The lack of country missions and in-country personnel created coordination problems. Rather than sustained projects, U.S. assistance often funded many short-term consulting missions that provided no sustained support to the recipient country.[11] In the past year or SO, efforts have been made to fund more long-term projects and to address some of these concerns.

Objectives and Coordination for U.S. Energy Assistance

The U.S. energy assistance program in Central and Eastern Europe has a range of objectives encompassing most sectors of the region's energy systems----energy production, oil and gas distribution systems, electric power, and end-uses in industry and buildings-and their environmental impacts. Projects have included policy and technical assistance, a sectoral adjustment grant to support energy price increases, human resource and institution building, and business development. The approaches to energy issues are also diverse, reflecting the different priorities and objectives of the U.S. Government agencies involved and somewhat different offices within those agencies.

Within several large framework projects described below, many smaller projects have been undertaken, ranging in size from several hundred thousand to several million dollars. Some specific energy activities have been mandated, notably $30 million in the SEED Act for energy and environmental projects in Krakow, Poland, but the implementing agencies have generally had flexibility in setting priorities for the additional $70 million in energy assistance disbursed or planned for Central European countries and the Baltics, and $15.6 million currently reprogrammed out of AID's Economic Support Funds in fiscal year 1992 to begin non-nuclear energy programs in Russia.

AID disburses energy assistance to Central and Eastern Europe, in cooperation with DOE and the Nuclear Regulatory Commission (NRC). DOE

[9] General Accounting Office, *Poland and Hungary: Economic Transition and U.S. Assistance*, GAO/NSIAD-92-102, May 1992, p. 26.

[10] Department of State, *SEED Act Implementation Report, Fiscal Year 1991*, supra note 7, p. 2.

[11] GAO, *Poland and Hungary*, supra note 9, pp. 28-36.

and EPA have also undertaken limited activities with their own appropriations. A number of other agencies are involved in support for trade and investment in energy goods and services in the region, including the Department of Commerce (DOC), the Export-Import Bank of the United States (Eximbank), the Overseas Private Investment Corp. (OPIC), and the Trade and Development Agency (TDA).[12]

Some initial coordination problems between the agencies over the allocation of energy funding were lessened through the formation of a State Department-led interagency Energy and Environment Working Group. The interagency working group no longer formally meets, but its members convene to discuss specific projects.[13]

There is also coordination and some joint projects with multilateral organizations and bilateral energy programs. Energy policy in Central and Eastern Europe has been developed on a consultative basis between Western multilateral and bilateral assistance programs and recipient governments. AID, DOE, the World Bank, the International Energy Agency (IEA), and others have collaborated on policy missions. For example, AID, the World Bank and the United Kingdom are currently collaborating on a power sector restructuring project in Poland.

Like the other SEED Act programs, the energy assistance effort has been developed largely on a regional basis. GAO reports that in at least one instance this approach caused some confusion among energy officials in the region, and made it difficult for them to plan around U.S. assistance.[14] However, GAO also notes that lack of organization and other problems within recipient countries has made absorption of aid difficult. More recently, as the energy situation has become somewhat more defined, U.S. energy projects are beginning to be developed on a country-specific basis. AID is coordinating this effort, and a number of country-specific projects are underway (see table 5-1).[15]

Federal Agencies Involved in Foreign Assistance for Energy

The major implementing agencies for nonnuclear energy assistance to Central and Eastern Europe-AID and DOE-have different institutional objectives that reflect their organizational structure and changing perceptions of their mission. AID is the primary U.S. Government agency involved in foreign assistance for energy. It is responsible for developing and implementing the energy assistance programs. AID's East European energy programs are managed by the Bureau for Europe in the Energy and Infrastructure Division, in coordination with the AID representative in each country. This organizational structure is a departure from traditional AID project management and reflects the U.S. Government's short-term approach to economic assistance in Central and Eastern Europe.

AID has been criticized for not having a clear energy policy, not supporting energy efficiency and renewable energy more consistently, and not devoting enough resources to energy in general. AID has been directed by Congress in recent years to increase its support for energy efficiency and renewable energy.[16] Energy efficiency has been a fairly major priority in Central and Eastern Europe. The energy assistance program in this region is designed to recognize the linkage between broader economic and energy sector

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12 The U.S. Trade and Development Program (TDP) became the TDA on October 28, 1992.

13 General Accounting Office, *East European Energy—U.S. Business Opportunities in and Assistance to Poland's Energy Sector*, Report to the Chairman, Committee on Energy and Natural Resources, U.S. Senate, GAO/NSIAD-91-206, May 1991, pp. 33-34.

14 GAO, *Poland and Hungary*, supra note 9, p. 32.

15 Personal communication, Robert Ichord, Chief, Energy and Infrastructure, Europe Bureau, Agency for International Development.

16 U.S. Congress, Office of Technology Assessment (OTA). *Fueling Development: Energy Technologies for Developing Countries*, OTA-E-516 (Washington, DC: U.S. Government Printing Office, April 1992), pp. 264-265.

Table 5-1—U.S. Energy Assistance to Central Europe: Summary of Major Current Project Areas by Selected Country

Poland

- Power Sector Restructuring, Privatization and Management
  - Multi-donor Energy Restructuring Program (with the World Bank, European Community, and United Kingdom)
  - Private Power Program and Electricity Tariff Reform
  - Utility Partnership Program
- Energy Efficiency and Demand Side Management
  - Energy Efficiency Centers (Warsaw and Katowice)
  - Demand Side Management and integrated Resource Planning
- Krakow Environmental Improvement
  - Skawina Power Plant Retrofit
  - Low Emissions Program
- U.S. Energy Business Development
  - Regional Business Development Officer

Czech and Slovak Republics

- Energy Efficiency and Environmental improvement
  - Development of Private Energy Services and Equipment Companies
  - Energy Efficiency Center (Prague) and Business Network Development
  - Energy/Environment Pilot Projects in Cesky Krumlov, Plzen, Ostrava, Bratislava
  - Oil Desulphurization and Natural Gas Substitution
- Power Sector Restructuring and Privatization
  - Utility Partnership Program
  - Power System Regulatory and Organization Reform
- Nuclear Safety
  - Nuclear Power Plant Operational Safety improvement
  - Regulatory Systems Improvement
- U.S. Energy Business Development
  - Capital Development initiative (CDI) Energy Business Development

Hungary

- Energy Efficiency
  - Training and Support to Private Hungarian Energy Service Companies
- Energy Sector Restructuring and Management
  - Utility Partnership Program
  - Power Sector Reorganization, Privatization and Finance
  - Development of New Mining Office
- Nuclear Safety
  - improve Plant Operation and Maintenance
  - improve Regulatory and inspection Systems
- U.S. Energy Business Development
  - CD Energy Business Development

Baltics

- Energy Pricing and Efficiency
  - Regional Electricity Price Reform
  - Demand Side Management and Energy Efficiency
- Power Sector Restructuring/Management
  - Utility Partnership Program
  - Electricity Sector Restructuring
- Nuclear Safety
  - Nuclear Safety in Lithuania

SOURCE: U.S. Agency for international Development

reforms and the achievement of energy efficiency in both supply and demand sectors.

The program's overall objectives include the decontrol of energy prices, energy sector restructuring, export promotion, pollution control, and nuclear safety. AID uses a number of mechanisms to implement program objectives: competitively selected contracts, a cooperative agreement with the U.S. Energy Association (USEA), interagency agreements with DOE, NRC, and the Department of Interior, and a grant to the International Energy Agency. Specific energy efficiency projects funded by AID, such as the Emergency Energy Project and Regional Energy Efficiency Project, are described later.

DOE's activities in Central and Eastern Europe are also diverse and reflect the different objectives and capabilities of the offices within the agency. DOE has developed a strategy toward the region, with the overall program goals being to assist in maintainingg a balanced and mixed supply of energy at reasonable prices and with reliability of supply; and to support the production, transport, and use of energy in ways that least damage the environment. Program elements include political and economic analysis, development of information systems, technical assistance, export promotion, and financing. DOE's activities are coordinated through an internal working group. Current projects focus on energy efficiency, fossil energy, and nuclear safety .17

Through its Office of Conservation and Renewable Energy and the Office of Industrial Technologies, DOE has supported several innovative projects, including three highly regarded energy efficiency centers and an energy efficiency export promotion program. An important element in DOE's future energy efficiency activities in the region is its efforts to expand export promotion of U.S. technologies and services, Under the Energy Policy Act of 1992 (PL **102-486),** DOE is authorized to administer, in cooperation with AID, a program to promote exports of energy technologies that can reduce emissions of greenhouse gases, with funding of $100 million annually.

EPA has also been seeking to expand its international activities, heretofore primarily confined to policy consultations and joint research programs, in the area of technology transfer and export promotion. Under the SEED Act, EPA has developed a number of environmental projects in Central and Eastern Europe, managed through its Office of International Activities. Its energy activities in the region have focused on renewable energy, particularly in the recovery and use of coal-bed methane, sealing leaks in natural gas pipelines, and supporting the energy efficiency centers, reflecting its domestic experience in these areas. EPA currently plans to increase its renewable energy activities in Central and Eastern Europe; its successful voluntary energy efficiency programs in the United States—such as "Green Lights" for lighting, "Energy Star" for computers, "Golden Carrot" for refrigerators—are planned for replication in Western Europe, and could also be expanded elsewhere.[18]

Assistance for Energy Efficiency

Energy efficiency has been a major component of the U.S. energy assistance program in Central and Eastern Europe. Policy and technical assistance and limited equipment purchases relating to energy efficiency have been undertaken in the context of three primary projects: Emergency Energy, Regional Energy Efficiency, and the Krakow Clean Fossil Fuel and Energy Efficiency Project. These projects have a combined budget of about $66 million, of which roughly one-third is devoted directly to energy efficiency.

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17 U.S. Department of Energy, ''Strategy For Eastern Europe: Scope Paper" (intend draft).

18 EPA, Th. *Climate is* Right *for Action: Voluntary Programs To Reduce Greenhouse Gas Emissions,* EPA 400-K-92-005, October 1992.

EMERGENCY ENERGY

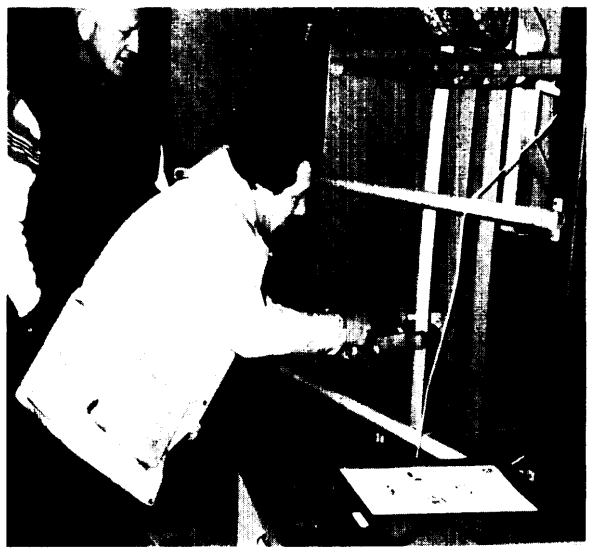
The Emergency Energy Project is an AID-managed $11.75 million project largely undertaken in 1991 in response to the perceived threat to Central European energy supplies and economies from increases in oil prices due to the Persian Gulf crisis and the decline in Russian oil deliveries. The project was developed by a joint team of representatives from AID, DOE, the Department of State, and U.S. industry in consultation with recipient governments in Poland, Hungary, the Czech and Slovak Republics, Bulgaria, Romania, and Yugoslavia. Its objectives were to improve industrial and oil refinery energy efficiency, oil purchasing practices, and the analytical basis for energy price reform.[19]

The industrial energy efficiency component of the project undertook energy audits in 52 industrial facilities in 9 countries. AID reports that it provided $1.5 million in energy efficiency equipment purchased from U.S. firms. As a result of the equipment and management measures, AID estimates that energy savings are $16 million/year. The project also stimulated local firms and consultants that were subcontracted to assist in the audits. Follow-on workshops, in the region and in the United States, and studies based on the audit findings also served to promote the project results and business opportunities.[20] Other measures to improve energy efficiency included audits in more than 20 oil refineries, energy pricing seminars for senior managers and policy makers, and development of economic models to assist in price reform.

REGIONAL ENERGY EFFICIENCY

The Regional Energy Efficiency Project is a 4-year, $34 million AID project initiated in 1991 and carried out through competitively awarded contracts. The project is implemented by a number of agencies and covers a broad set of activities, which include:

- rationalization and decontrol of energy prices;
- restructuring the energy sector and promotion of energy efficiency and the privatization of energy companies;
- promotion of U.S. investment, joint ventures, and technology transfer;
- reduction of environmental pollution;
- improving nuclear safety; and
- integration of energy systems with Western Europe and international energy markets .21


U.S. AID

Measuring electrical effciency at a Yugoslav paper plant using U.S. equipment.

The major project element devoted to energy efficiency is the ''Energy Pricing, Energy Efficiency, and Energy Sector Restructuring' component ($6.4 million) begun in June 1992, that provides technical assistance, training, and low cost energy efficiency equipment to public and private sector entities, through AID-managed contracts. The project will assist in promoting

19 USAID, ''Emergency Energy' (Project Summary and Progress Report, 1992).

20 The Alliance t. Save Energy's study, *Business Opportunities* in Eastern *Europe for Energy-Efficient Industrial Products,* supra note 5, is based on this project.

21 USAID, ''Region~ Energy Efficiency' (Project Summary and Progress Report, 1992).

competition in energy markets through further price reforms and the establishment of regulatory frameworks. It will also aim to stimulate energy efficiency and the development of private energy service and equipment supply companies linked with U.S. firms.[22]

Other major project elements include the "Electric Power Systems and Related Fuel Supply" component ($5.7 million), that will, among other objectives, provide technical assistance and training in the management of electric generation, transmission and distribution systems, and conduct feasibility studies for the efficiency improvement and rehabilitation of power plants. Some of these activities will be carried out by AID-managed contracts in collaboration with the World Bank, EC, and the United Kingdom.[23]

Under this project, AID has also entered into a cooperative agreement with USEA to form the U.S.-Eastern European Utility Partnership Program (UPP). Begun in October 1991, UPP brings together electric utilities in the United States and Central and Eastern Europe for activities focused largely on management issues but including also art annual regulatory systems seminar and dissemination of information and software resources. The Program has received wide support from the U.S. utility industry, including the Edison Electric Institute, Electric Power Research Institute, and the North American Reliability Council. U.S. utilities will share the costs of the program, contributing $1 million, or one-fifth of the program's budget.[24]

The first partnership was formed between New England Electric Systems and a Hungarian power company in April 1992, and others are being developed between Commonwealth Edison and the Polish Power Grid, Houston Lighting and Power and the Czech Power Co. (CEZ), Southern Co. and the Slovak Power Utility (SEP), and Central Maine Power and the Bulgarian National Electric Co. Further partnerships are planned with the Baltics and Romania. AID also reports that over 20 companies have expressed interest in joining the partnership program.[25]

Another component of the Regional Energy Efficiency Project provides funds to DOE for: 1) promotion of cleaner and more efficient combustion of coal; and 2) end-use efficiency and renewable energy, including support for and establishment of energy efficiency centers. The coal assistance is managed by DOE's Fossil Energy Office and the energy efficiency/ renewable work by Pacific Northwest Laboratories (PNL) under the DOE Renewable Energy Office.

The $20 million "Krakow Clean Fossil Fuel and Energy Efficiency Project' assists in reducing Krakow's air pollution problems by improving the efficiency of the city's district heating system and energy use in buildings. Phase I ($5.5 million) of this project has involved technology assessments and feasibility studies; in phase II ($14.5 million), DOE will jointly fund commercial joint ventures to provide the fuels and technologies prescribed.[26] Other technical assistance projects include several focused on improving energy efficiency in the Krakow Polish-American Children's Hospital and in the buildings sector generally in Plzen and Cesky -

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22 SYCOM, a energy service fii that is a joint venture of Bechtel Corporation and Pacific Gas and Electric, is a member of the consortium implementing this project. U.S. Agency for International Development, Bureau for Europe, "New Eastern and Central Europe Energy Contract" Apr. 24, 1992.

23 USAID, "Regional Energy Efficiency," supra note 21.

24 USAID/U.S. Energy Association, *U.S.-Eastern European Utility partnership program: Status Report, October 1991-May 1992;* USAID, "Regional Energy Efficiency," supra note 21.

25 USAID, "Regional Energy Efficiency, " supra note 21.

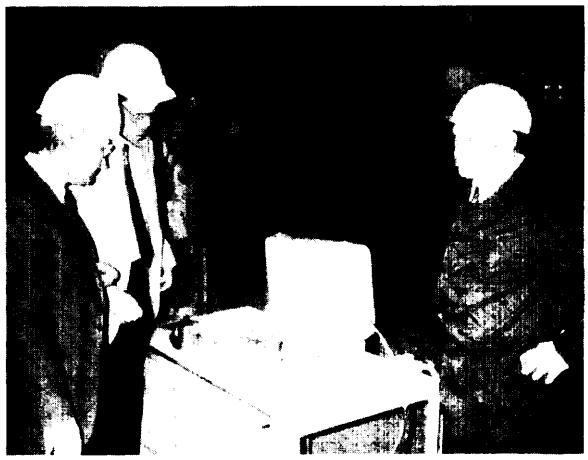
26 USAID, "Krakow: Skawina Retrofit and Clean Fossil Fuel and Energy Efficiency" (project *Summary* and Progress Report, 1992).

Krumlow in the Czech Republic, and in Bulgaria.[27]

One of the more innovative and cost-effective energy efficiency assistance projects has been the establishment of three private, nonprofit centers for energy efficiency: the Polish Foundation for Energy Efficiency (FEWE), with offices in Warsaw and Katowice, founded in 1991; the Czech and Slovak Center for Energy Efficiency located in Prague (SEVEn), founded in 1990; and the Moscow Center for Energy Efficiency (CENEf), founded in 1992. A center is also planned for Bulgaria. The centers are staffed by local energy efficiency experts (between 5 and 10 in each center) with assistance from U.S. experts. They receive rather limited U.S. seed funding (a total of $400,000 in fiscal year 1991; $600,000 in fiscal year 1992), and are intended to become self sustaining within 3 years.[28]

The center's activities are focused in four main categories: policy research and development, private business venture development, training and demonstration projects, and public education and information services. The centers have conducted seminars for local and national government policy makers on management, planning, and standards for energy efficiency and have acted as advocates for implementing such programs. The centers are also serving as clearinghouses for information on energy efficiency technologies. As a follow-on to the center's promotion of integrated resource planning (IRP), DOE is also planning to provide U.S. IRP experts to Poland and the Czech and Slovak Republics in 1993.

DOE and the energy efficiency centers also attempt to promote business development, which will be discussed below in the section on trade and investment.


U.S. AID

U.S. equipment provided to measure boiler efficiency at the Loz, Poland district heating plant.

ACTIVITIES IN THE NEWLY INDEPENDENT STATES

Energy assistance efforts for the NIS began in mid- 1992, with a $15.6 million effort that included energy efficiency audits and followup purchases of equipment in district heating plants in Russia, Khazakstan, Belarus, Armenia, Ukraine, and Kyrgyzstan.[29] The initial energy priorities, if not emergencies, facing the NIS are nuclear power safety and reviving oil and gas production. It is not clear at this time what major funding for energy efficiency is likely over the coming years.

BILATERAL ENERGY COOPERATION AGREEMENTS

DOE has begun to establish formal institutional ties with countries in Central and Eastern Europe relating to energy cooperation. Terms of Reference have been concluded with the Ministry of Trade and Industry in Hungary that provide for, among other things, assistance in developing an energy information system and evaluating approaches to energy regulation. Energy cooperation with Russia and the other newly independent

27 Pacific Northwest Laboratories, *Annual Report—Program for Energy Efficiency Assistance: Eastern Europe and Newly Independent States*, pp. 11-12.

28 Ibid, pp. 5-6.

29 Other program areas are nuclear safety, oil and gas production, electric power pricing and privatization, and coal mine safety. USAID, "Factsheet: USAID Energy Program in the New Independent States (NM) of the Former Soviet Union," June 30, 1992.

states has also been initiated. U.S.-U.S.S.R. energy cooperation was focused on nuclear power, although an agreement on exchanges in the power sector was in effect from 1973 to the mid-1980s. Under DOE auspices, the United States and the Russian Federation signed a framework Agreement on Scientific and Technical Cooperation in the Field of Fuel and Energy in June 1992. The Agreement provides for data exchanges, joint projects, and private sector contacts in a number of energy areas, including energy efficiency and renewable. The Agreement establishes a U. S.-Russian Joint Commmittee, which will meet once annually organized by DOE and the Ministry of Fuels and Energy of the Russian Federation.

Research and Development

The U.S. energy assistance program currently lacks a consistent R&D (and demonstration) component that would allow emerging energy efficiency technologies to be developed in accordance with opportunities in Central and Eastern Europe.

Science and Technology (S&T) Agreements have been signed with Poland (renewed in 1987), Hungary (1989), Czechoslovakia (1991), and Yugoslavia (suspended). The agreements are administered by the Bureau of Oceans and International Environmental and Scientific Affairs (OES) in the Department of State. Funding for activities under the agreements are appropriated through the Department of State budget, and augmented by participating government agencies. The S&T funds support add-on costs of bilateral cooperation, and do not serve as primary sources of funding for domestic research.[30] Energy typically makes up about one-tenth of the S&T budget. In 1990, seminars were held in Poland on the U.S. experience with energy conservation under the U.S.-Poland S&T Agreement.

In Russia and the other newly independent states, previous science and technology agreements are being reassessed, and efforts have been underway to support the existing science and technology infrastructure and assist in conversion from military applications. The United States has been instrumental in establishing the International Science and Technology Center headquartered in Moscow. The United States, Canada, Sweden, and Ukraine have also signed an agreement to establish a Science and Technology center in Kiev. Energy and environment are expected to be priorities for the center.[31]

Trade and Investment Programs

U.S. programs in Central and Eastern Europe have been strongly oriented toward private sector development and U.S. trade and investment. DOC, AID, and DOE have programs devoted to facilitating U.S. business opportunities generally as well as in the energy sector, including some of the projects discussed above, such as energy efficiency centers. The autonomous U.S. export assistance and investment agencies—Eximbank, OPIC, and TDA—are also active in most countries in Central and Eastern Europe, providing pre-export assistance, such as for feasibility studies, export financing, and insurance and guarantees to cover political and economic risks.

The American Business Initiative (ABI), a 4-year, $46 million interagency initiative involving Commerce, AID, TDA, and OPIC, is the framework for some of these activities and also assists in coordination. ABI's six programs, including the Capital Development Initiative (discussed later), targets five industry sectors that are key to economic reform and growth. They are energy, environment, telecommunications, hous-

30 Finding for the S&T agreements is minimal. Total funding for all the agreements in FY 1991 was $4.5 million. *SEED Act Implementation Report, Fiscal Year 1991,* supra note 7, p. 17.

31 U.S. Department of State, Office of the Assistant Secretary " U.S., Canada, Sweden and Ukraine Initial Agreement Establishing Science and Technology Center in Kiev" (Press Release, June 2, 1992).

ing, agriculture, and agribusiness. The United States has also provided the capital for "Enterprise Funds' in Poland, Hungary, and the Czech and Slovak republics which can assist in business development.

As discussed below, these programs have provided a framework for trade and investment in energy technologies and services that improve efficiency, although heretofore primarily in the power sector and for larger firms. Eximbank has supported a number of energy sector exports to Poland and Hungary. U.S. firms have also invested in companies that produce energy equipment with OPIC coverage—including General Electric Co., which purchased the Hungarian lighting manufacturer, Tungsram, and Magne-Tek, Inc.

However, the smaller firms that typify the market for end-use energy efficiency products and services-henceforth the energy efficiency industry-have not done much business in the region. This is in great part due to this industry's orientation toward the U.S. domestic market and lack of systematic organization for exporting.[32] Efforts to organize the industry for export are in the nascent stages, through nongovernmental organizations, such as the Alliance to Save Energy and the International Institute for Energy Conservation, a newly forming export council for the energy efficiency industry, and forthcoming efforts under proposed DOE-coordinated COEECT.

It should be noted that there are factors that could affect the ability of the energy efficiency industry to mobilize for exporting. Recent studies by OTA, GAO, and others have cited, among other factors, poor coordination among U.S. export assistance programs and no overarching export strategy, limited access for small and medium-sized businesses, and inadequate resources and excessive restrictions compared to major U.S. competitors.[33] Some of these issues will be examined in more depth below.

PROMOTION OF TRADE AND INVESTMENT

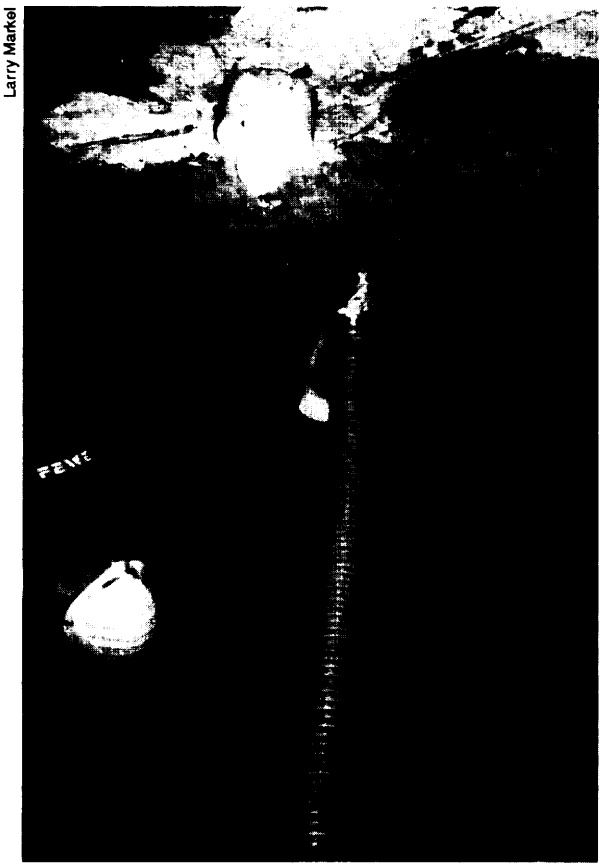
There is an extensive framework of activities to promote trade and investment in Central and Eastern Europe, supported by DOC, AID, TDA, and OPIC, and including market information systems, business development centers, trade missions, and fairs. DOC has promoted opportunities for power sector and other energy (e.g., buildings technologies) equipment exports, while DOE and the energy efficiency centers have attempted to target the energy efficiency industry.

DOC has a number of programs providing information, promoting exports, and creating a U.S. presence in the region. The Eastern European Business Information Center (EEBIC) acts as a clearinghouse on trade and investment opportunities for U.S. businesses. The EEBIC publishes the *Eastern Europe Business Bulletin,* on a monthly and sometimes bimonthly basis, which includes general information on trade and investment as well as specific business opportunities in the energy sector and in energy equipment. It also produces the occasional publication, *Eastern Europe Looks for Partners,* which provides information on joint ventures in specific sectors. To speed access to these services and others, the EEBIC has an automated fax delivery system, EEBICFLASH.

Commerce established a similar program in June 1992 for the newly independent states, the

[32] Russell Sturm, Deidre Lord, and Lynn Wagner, *Seizing the Moment: Global Opportunities for the U.S. Energy Efficiency Industry, A Report of the Office of Energy Conservation and Renewables,* U.S. Department of Energy, October 1992.

[33] Examples from this growing literature include: Office of Technology Assessment, *Competing Economies: America, Europe, and the Pacific Rim,* OTA-ITE-498 (Washington, DC: U.S. Government Printing Office, October 1991); William E. Nothdurft, *Going Global: How Europe Helps Small Firms Export* (Washington, DC: The Brookings Institution, 1992); and James Altschul, *The Export Finance Crisis* (Washington, DC: Economic Strategy Institute, July 1992). The General Accounting Office has published several reports on export assistance programs, including Export ***Promotion: A Comparison*** *of* ***Programs*** *in Five Industrialized* Countries, GAO/GGD-92-97, June 1992, and *Export Promotion Federal Programs Lack Organizational and Funding Cohesiveness,* GAO/NSIAD-92-49, January 1992.



U.S. machinery and tools are used to insulate apartment building in Krakow, Poland. (AID Project)

Business Information Service for the Newly Independent States (BISNIS). Like the EEBIC, BISNIS provides a monthly newsletter, marketing plans, and other information of use to potential exporters.

The U.S. and Foreign Commercial Service undertakes export promotion activities in the region. Electric power technologies are promoted as a "best prospect' for U.S. trade. Commerce has sponsored several trade missions promoting energy and environmental goods and services, including energy efficiency technologies.

More focused **activities on the** energy efficiency industry are currently being undertaken under the DOE/PNL project, Energy Efficiency Assistance program for Eastern Europe and Newly Independent States. This effort is focused on utilizing the capabilities of the energy efficiency centers, and includes creating U.S. liaison support between the centers and U.S. companies, developing an Automated Eastern Europe and Newly Independent States Information System, and other business development activities. For example, the Czech and Slovak center, SEVEn, is initiating a series of Energy Efficiency Business Weeks. The frost was held November 30 to December 4, 1992. The project estimates that 50 U.S. firms have been provided assistance.[34] (See table 5-2.)

PRE-EXPORT FINANCING

A number of U.S. Government agencies provide financial assistance for prefeasibility and feasibility studies, training and other services that can assist in the export of U.S. energy efficiency goods and services, including TDA, Eximbank, OPIC, AID and the small International Fund for Renewable Energy and Energy Efficiency (IFREEE). By assisting U.S. firms in the early stages of project development, these programs can help position the firms for follow-on exports.

The TDA is the major source of financing for feasibility studies in Central and Eastern Europe, and also provides consulting services, training programs, and other project planning services, and identifies development projects that offer large export potential. The TDA is a relatively small program, funded at $35 million in fiscal years 1991 and **1992,** but it has a strong record in stimulating follow-on U.S. exports.[35] Energy and natural resource projects have made up the largest share of TDA's projects and obligations in recent years. TDA activities in Central Europe include

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34 Pacific Northwest Laboratories, *Annual Report—Program for Energy Efficiency Assistance,* **supra** note 27, PP. 7-9.

35 United States Trade and Development Program (TDP), Congressional/ *Presentation, Fiscal Year* 1993; TDP, "The Trade and Development program in Central and Eastern Europe" (October 1992).

Table 5-2—Support for U.S. Firms by Energy Efficiency Centers

Type of Energy Efficiency Product	CENEf[a]	SEVEn[b]	FEWe[c]
Energy Efficiency Technologies	**6**	**26**	**8**
Insulation & Energy Efficient Construction Materials	**2**	**8**	1
Cogeneration Equipment	**3**	11	**5**
Renewable Energy Technologies	3	**13**	**5**
Energy Conservation Services (DSM,[e] IRP,[f] and others)	**2**	**18**	**15**
Coalbed Methane Technologies	**1**	**NA**	20
Cement Technologies	1	**NA**	**2**

a) Center for Energy Efficiency (Moscow)
b) Center for Energy Efficiency (Prague)
c) The Polish Foundation for Energy Efficiency
e) Demand-side management
f) Integrated resource planning

NA - Not applicable.

SOURCE: Battelle Pacific Northwest Labs, ***Annual Report-Program for Energy Efficiency Assistance.***

several feasibility studies for rehabilitating thermal power plants and modernizing electric power transmission systems, and support for a conference on U.S. electric power technologies.

Eximbank and OPIC also provide financing for feasibility studies. Under the American Business Initiative, OPIC can offer project development assistance for up to 50 percent, or 75 percent for small businesses, of the cost of feasibility studies and business development plans,[36]

The AID-managed Capital Development Initiative (CDI) ($10-15 million) is another effort to assist U.S. firms in trade and investment under the American Business Initiative. The CDI is focused on Poland, Hungary, the Czech Republic, and the Slovak Republic, but includes also the Baltics and other Eastern European countries outside the NIS. U.S. consulting firms paired with Eastern European counterparts have been retained by AID to manage the CDI, and assist U.S. companies in identifying and pursuing investment opportunities. Energy is one of the initial components of the CDI, with management by ICF Resources, a Virginia-based firm. The CDI also provides a Development Cost Support Fund that can grant up to 50 percent or $500,000 toward the preparation of a project for investment financing.[37]

There are a number of other small energy preproject assistance programs that could provide support for energy efficiency projects in Central and Eastern Europe. AID supports an Energy Project Development Fund, which can provide up to 50 percent of funding for prefeasibility and feasibility studies. The fund is devoted to financing energy projects that can demonstrate environmental benefits, and to assisting U.S. companies in trade and investment. The IFREEE, a nonprofit Washington-based corporation funded by AID, DOE, EPA and the Rockefeller Foundation, attempts to facilitate access to private and public financing for industries in the renewable energy, energy efficiency, and natural gas sectors. The first year's programs have focused on renewable energy projects, but some energy efficiency projects are in the pipeline.

EXPORT FINANCING AND INSURANCE

U.S. export financing and insurance programs play an important role in facilitating trade and investment in Central and Eastern Europe, given the current constraints on commercial financing

36 USAID, "American Business and Private. Sector Development Initiative" (Project Summary and Progress Report, 1992).

37 Ibid.

and the risks of doing business in the region. Eximbank's programs are designed to support exports that would not otherwise attract private sector financing, by offering loans with longer term maturities, providing export credit insurance, and countering export credit subsidies of foreign governments. The Foreign Credit Insurance Association (FCIA), a private sector consortium affiliated with Eximbank, provides insurance for Eximbank loans. OPIC offers political risk insurance, financing through direct loans and/or loan guarantees, and loan services to U.S. private investors. Both Eximbank and OPIC support energy firms extensively, including smaller renewable energy companies.

Eximbank exposure in Poland, Hungary, and Czechoslovakia as of fiscal year 1991 was about $377.6 million, most of which is in Poland.[38] This includes loans and guarantees to support power sector exports to Poland and Hungary .39 Companies doing business with Hungary and the Czech and Slovak republics now have access to medium-term insurance and long-term loans and guarantees; loans and guarantees to Poland are limited to 5 year-s amortization and 7-year total term.[40] Loans, guarantees, and insurance to other countries in the region are on a more restricted basis. Table 5-3 summarizes the limitations of Eximbank programs in Central and Eastern Europe as of November 1991.

There has been some concern that Eximbank is too cautious in supporting exports to the region. Exports of capital goods, such as energy technologies, that require a large up-front investment for long-term payback, require longer term financing and insurance. The Advisory Committee of Eximbank has recommended that the situation in Central and Eastern Europe requires "new and imaginative initiatives enabling Eximbank to identify the underlying strengths of these economies, and therefore making it possible for exporters to position themselves in these markets during their early development stage. "[41]

U.S. direct investment in Central and Eastern Europe can help stimulate the local economies, facilitate private sector development, and provide avenues for transfer of technologies and management skills, In 1990 and 1991, OPIC provided insurance and loan guarantees to almost 50 fins-ranging from small to large but with an emphasis on larger firms-to support investments in Central and Eastern Europe. These included firms producing renewable energy (methane recovery), refrigeration insulation, electric motors, and lighting products (General Electric Corp.). Total exposure in the region was $550 million by the end of fiscal year 1991.[42]

OPIC has also authorized a Central and Eastern Europe Growth Fund with a $50 million investment guarantee, which is in the process of being capitalized. The Fund will invest in equity and debt securities of firms that have a sound financial condition, potential for growth, and can demonstrate positive developmental benefits.[43] OPIC has also authorized a $100 million Environmental Investment Fund (also in the process of being capitalized), which will invest in projects in five

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38 Total exposure as of that year was almost $27 billion. Export-Import Bank of the United States, *Annual Report, 1991,* pp.16-19.

39 Eximbank provides a significant amount of insurance, loan and guarantee support for energy exports and investment, primarily in power generation and oil and gas sectors-almost $2.9 billion in fiscal year 1991 and $2.4 billion in fiscal year 1992, according to Export-Import Bank, Office of Public Affairs, "Eximbank's Loan and Guarantee Support For Energy Exports" (Oct. 22, 1992).

40 Export-Import Bank of the United States, "CountryLimitation Schedule: Special Conditions Pertaining to Eximbank Loan and Guarantee Programs and Export Credit Insurance" (Effective Nov. 15, 1992).

41 Export-Import Bank of the United States, *Report to the U.S. Congress on Export Credit Competition and the Export-Import Bank of the United States for the Period January 1,1991 through December 31, 1991,* July 1992.

42 Overseas Private Investment Corporation, *1990 Annual Report* and 1991 *Annual Report.*

43 OPIC, "Informational Summary: Central and Eastern European Growth Fund" (no date).

Table 5-3—Central and Eastern Europe-Eximbank Programs

	Short-term insurance	Medium-term insurance	Medium-term Loans/guarantees	Long-term
Albania	No	No	No	No
Bosnia	No	No	No	No
Bulgaria	Yes	No	No	No
Croatia	No	No	No	No
Czechoslovakia	Yes	Yes	Yes	Yes
Estonia	Yes	No	No	No
Hungary	Yes	Yes	Yes	Yes
Latvia	Yes	No	No	No
Lithuania	Yes	No	No	No
Poland	Yes	Yes	Yes	No
Romania	Yes	No	No	No
Slovenia	No	No	No	No
Yugoslavia	No	No	No	No
Armenia	No	No	No	No
Azerbaijan	No	No	No	No
Belarus	Yes	No	No	No
Georgia	No	No	No	No
Kazakhstan	Yes	No	No	No
Kyrgyzstan	No	No	No	No
Moldova	No	No	No	No
Russia	Yes	Yes	Yes	No
Tajikstan	No	No	No	No
Turkenistan	No	No	No	No
Uzbekistan	Yes	No	No	No
Ukraine	Yes	No	No	No

SOURCE: Eximbank, July 27, 1992,

environmental sectors, including renewable and alternative energy.[44]

Many of the firms in the U.S. energy efficiency industry are small and could have difficulty approaching Eximbank and OPIC, which tend to finance larger firms. Since 1986, Eximbank has been required to set aside IO percent of its total budget authority to finance small business exports. In recent years, this target appears to have been met and sometimes exceeded.[45] Eximbank has taken a number of other steps recently to improve access to small businesses, including increasing locations that can represent its programs at the State and local level, and forming a Small Business Group to assist in streamlining and improving its programs. The Small Business Administration (SBA) also provides export financing for small businesses through its Export Revolving Line of Credit, although this program has apparently not been widely used.[46]

ENTERPRISE FUNDS

The Polish-American Enterprise Fund (1990), the Hungarian-American Enterprise Fund (1990J

44 The other program areas for the Environmental Investment Fund are sustainable agriculture, forest management, ecotourism, and pollution prevention and abatement technologies. OPIC, ''Informational Summary: The Environmental Investment Fund'' (notate).

45 There has been some ambiguity about Eximbank's reporting of its support for small business exports in that direct support was not distinguished from indirect support to small businesses that contracted to larger firms. The recent legislation for Eximbank reauthorization requires the bank to calculate only direct support for small business. *General Accounting Office, The U.S. Export-Import Bank: The Bank Provides Direct and Indirect Assistance to Small Businesses, GGD-92-105,* August 1992.

46 General Accounting Office, *Export Promotion: Problems in the Small Business Administration's programs,* GGD-92-77, September *1992.*

and the Czech and Slovak-American Enterprise Fund (1991) were established under the SEED Act to undertake a number of activities in support of private sector development, including making loans, grants, and equity investments, and sponsoring technical assistance and training. The funds emphasize the financing of firms in the recipient countries and joint ventures with U.S. fins, but will also finance U.S. companies doing business in the recipient countries. The funds are oriented to small and medium-sized fins. Anecdotal accounts suggest that the enterprise funds have not responded favorably to environmental and energy service companies.

The Polish and Hungarian funds were authorized at $240 million and $60 million, respectively, over fiscal years 1990-92. By fiscal year 1991, the Polish Fund was capitalized at $104 million and the Hungarian Fund at $26 million. The Czech and Slovak Fund was seeded with $10 million in fiscal year 1991 and authorized for $65 million. The funds may raise additional capital from the private sector and foundations.[47]

U.S. Energy Efficiency Industry Export Potential

U.S. Government programs for trade and investment offer a wide array of resources for firms in the energy efficiency industry, including small fins, that could export to Central and Eastern Europe. However, the industry is not well organized to export, nor is there a government-wide strategy for mobilizing the industry. U.S. Government energy efficiency export activities have begun in limited fashion under the DOE coordinated Committee on Renewable Energy, Commerce and Trade (CORECT), established by Congress in 1984 to promote the use abroad of U.S. renewable energy goods and services, but will be developed more extensively under the DOE Committee for Energy Efficiency, Commerce, and Trade (COEECT) program. COEECT, like CORECT, will be an interagency initiative with private sector participation, that mobilizes resources to assist in export of energy efficiency technologies and build a government-industry partnership.[%] Central and Eastern Europe is targeted as the initial priority market for COEECT, given the framework for business development already in place.

State and Nongovernmental Activities

While the Federal Government is the largest U.S. funder of energy activities, a number of public utilities and private organizations have provided policy guidance and attempted to facilitate private sector involvement in energy efficiency.[49] participants in the Utility partnership program noted earlier include the New England Electric Systems, Commonwealth Edison, Houston Light and Power, Southern Co., and Central Maine Power.

A number of nongovernmental organizations have programs focused on researching and implementing energy efficiency in Central and Eastern Europe, and also in mobilizing U.S. firms to export. The Alliance To Save Energy has been informally organizing energy efficiency industries to export under its World Export Program, including to Central and Eastern Europe, and has assessed business opportunities in industrial energy efficiency in the region.[50] The International Institute for Energy Conservation (IIEC) has recently opened an office in Brussels from which

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47 *SEED Act Implementation Report, Fiscal Year 1991*, supra note 7.

48 An industry analysis prepared to support COEECT is Russell Sturm et al, *Seizing the Moment: Global Opportunities for the U.S. Energy Efficiency Industry*, supra note 32.

49 The Citizens Democracy Corps publishes a compendium of U.S. nonprofit assistance that includes selected energy activities. Citizens Democracy Corps (CDC) Clearinghouse, *Compendium: U.S. Nonprofit Assistance to Central and Eastern Europe and the Commonwealth of Independent States (3* vols.), (Washington DC: CDC, 1992).

50 Alliance t. Save Energy/International Institute for Energy Conservation, A *Resource Guide for Exporting Energy -Efficient Products* (Washington DC, 1991); and *Business Opportunities in Eastern Europe for Energy-E ;fficient Industrial Products*, supra note 5.

to assess projects in Central and Eastern Europe. The American Council for an Energy Efficient Economy (ACEEE) has supported the work of the energy efficiency centers in Central and Eastern Europe. The Natural Resources Defense Council NRDC) is undertaking energy efficiency projects in Belarus and other republics. The Center for Clean Air Policy has established a State Energy and Environment Exchange Program in the Czech and Slovak Republics, from which projects in energy conservation and energy regulatory policy are planned. The Sister Cities program is exploring energy partnerships between a U.S. and Polish city.

Other recent initiatives include a newly forming export council for energy efficiency technologies and services, and a proposal by the Atlantic Council to organize a World Council for Energy Efficiency that would assist the countries of Central and Eastern Europe, and the developing world, in accessing information on energy efficiency programs, technologies, and measures.[51]

MULTILATERAL PROGRAMS

A review of multilateral assistance in energy to Central and Eastern Europe found at least 14 multilateral organizations, institutions, lending agencies, and initiatives.[52] Multilateral development banks, particularly the World Bank Group and the EBRD have provided the bulk of financing for energy projects in Central and Eastern Europe. The Global Environment Facility, now the interim financing mechanism for the Framework Convention on Climate Change, will also become more active in financing energy projects with environmental benefits, including energy efficiency.[53] Other multiateral organizations, such as the IEA and the U.N. Economic Commission for Europe (UN ECE), have policy research and information systems programs that have been extended to Central and Eastern Europe. The activities of these organizations will be reviewed in this section.

Also reviewed below is the European Energy Charter, a European Community initiative, that has been developed on a multilateral basis, to create a legal and policy framework for energy trade and investment and international energy cooperation. The charter was conceived as a means to integrate Central and Eastern Europe in world energy markets.

A tentative UN ECE evaluation of the multilateral energy assistance programs (that included also the European Community programs) found that they had succeeded in avoiding duplication of effort, but also characterized the coordination as not very consistent. Energy programs are often announced to other donors after the fact. Multilateral lending was found to be ‘‘limited, slow, supply-oriented, and uneven. ’ Alternative approaches to financing, such as shared savings agreements, energy service agreements, joint ventures, and third-party financing, were ‘‘not sufficiently propagated. ’ The evaluation also recommended ‘multiplying small-scale develop-

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51 The Council was proposed in The Atlantic Council, *Energy Technology Cooperation for Sustainable Economic Development,* Policy Paper Series, September 1992, p. 27.

52 U.N. Economic and Social Council, Economic Co remission for Europe, ***Multilateral*** *Assistance to Economies in Transition in the Field of Energy,* supra note 1, p. 9.

53 The Framework Convention on Climate Change was signed by the United States and over a hundred other countries in Rio de Janeiro in June 1992, and ratified by the U.S. Congress in October 1992. It could take several years to go into force internationally, which requires 50 countries to ratify. The convention is designed to begin a process of reducing emissions of greenhouse gases, of which the Central and Eastern European countries are major sources-particularly of carbon dioxide (CO_2) released by combustion of fossil fuels and methane or natural gas (CH_4) released from coat mines and leaks from natural gas systems. “United Nations Framework Convention on Climate Change, ” U.N. General Assembly, A/AC.237/18 (Part II)/Add.1, 15 May 1992. For a review of the scientific and technical issues involved in climate change policy, see OTA, ***Changing By Degrees*** (Washington, DC: U.S. Government Printing Office, 1991).

54 U.N. Economic and Social Council, **Multilateral Assistance to** *Economies in Transition in the Field of Energy,* supra note 1.

ment assistance. . rather than financing a few large-scale projects. "[54]

The World Bank Group[55]

The World Bank (IBRD) is the largest single funder of energy projects in Central and Eastern Europe, lending about $2 billion from 1980 to 1991.[56] The Bank has had a major influence on energy sector reform in the region through conditions in its structural adjustment loans, including pricing reforms and restructuring and privatization of energy-sector enterprises. The Bank's major current energy projects in the region, totaling almost $1 billion, focus on modernizing energy supply and conversion infrastructure, in district heating, natural gas, and in the power sector (box 5-B). There are no end-use efficiency projects currently being financed, although three smaller loans, totaling almost $100 million, were provided to Hungary over the 1980s for industrial energy efficiency. The Bank also operates the Central and Eastern Europe Network for Regional Energy (CEENERGY), in coordination with the EC, United States, and the IEA, a program that seeks to facilitate technical assistance and preinvestment activities in high-priority areas. CEENERGY currently supports preliminary studies of energy efficiency in the context of analysis of energy-related environmental impacts .57

The Russian Federation became a member of the World Bank in June 1992, but the Bank has not yet begun project lending to Russia or the other countries of the NIS. A Bank review of Russian economic reform has identified the priority elements of an initial energy policy package, consisting of energy price reform and the development of a regulatory framework to stimulate investment in the oil and gas sectors.[58]

While recognizing the potential for end-use efficiency in Central and Eastern Europe, the Bank has stressed energy pricing and regulatory reform as the primary means to encouraging greater efficiency. Overall, end-use efficiency has not been a significant element in Bank energy lending-as low as 1 percent according to one estimate.[59] In a previous study, OTA found that three primary factors militate against the finding of energy efficiency projects at the World Bank: first, they are more diverse and complex than conventional energy supply projects and harder to put into a project format for lending; second, results of energy efficiency initiatives are hard to forecast and incorporate into supply plans; and third, the past emphasis on traditional supply projects is difficult to change.[60]

The Bank has taken some steps recently to increase its incorporation of energy efficiency in energy project development and lending. A strategy for energy conservation lending is under discussion, and supports better integration of

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54 U.N. Economic and Social Council, *Multilateral Assistance to Economies in Transition in the Field of Energy,* supra note 1.

55 The World Bank Group consists of the International Bank for Reconstruction and Development (IBRD), the International Development Association (IDA), the International Finance Corporation (IFC), and the Multilateral Investment Guarantee Agency (MIGA).

56 In 1991, Bank energy lending to the region equaled 23 percent of its total energy lending. Lending commitments to Central and Eastern Europe (excluding the NIS) equaled 18 percent of overall Bank lending in fiscal year 1991. See Joerg-Uwe Richter, "Energy Issues in Central and Eastern Europe: Considerations for International Financial Institutions, " *Energy Journal,* vol. 13, No. 3, 1992, pp. 274-277.

57 Other priority areas for CEENERGY include: Soviet energy exports and their impact on Central and Eastern Europe; Petroleum Refining and Transport; Electrical Power Interconnection and Trade; and Natural Gas Trade. Montfort and Wackman, ''The World Bank Support for Energy Sector Transformation in Central and Eastern Europe," pp. 15-16.

58 The World Bank, Russian Economic *Reform: Crossing the Threshold of Structural Change* (Washington, DC: World Bank, September 1992), pp. 180-81.

59 Michael Phillips, *The Least Cost Energy Path for Developing Countries: Energy Efficient Investments for the Multilateral Banks (Washington DC:* International Institute for Energy Conservation@ September 1991)

60 OTA, Fueling *Development,* supra note 16, p. 268.

Box 5-B-Recent World Bank Energy Projects in Central and Eastern Europe

Poland

Structural Adjustment Loan ($300 million/July 1991).

Energy sector conditionality included decontrol of coal prices and phased removal of energy related subsidies and cross subsidization.

Energy Resource Development Project ($250 million, World Bank; $60 million, European Investment Bank; $338 million, Polish governrment/June 1990).

Focused on increasing production and use of natural gas, this project also supported increases in gas prices and studies of restructuring and demonopolization in the gas, power, district heat, and coal subsectors.

Heat Supply Restructuring and Conservation Project ($340 million, World Bank; $50 million, EBRD/June 1991).

This project supports energy pricing reform and improves energy conservation in the district heating sector by rehabilitating existing infrastructure and introducing energy efficient equipment.

Cogeneration Privatization Project (Tentative loan amounts: $85 million, World Bank; $30 million, commercial banks/spring 1993).

Combined heat and power production will be introduced in Krakow.

Czech Republic and Slovak Republic

SAL Structural Adjustment Loan I ($450 million/June 1991).

Energy related conditionality included energy price reform, energy sector regulation, and introduction of an environmental plan.

Power and Environmental Improvement Project ($246 million, World Bank; $311.5 million, Czech Republic and Slovak Republic/May 1992).

Focused on reducing air pollution in Northern Bohemia, this project includes some efficiency improvements in the electric power sector, particularly in the transmission system.

Slovak Power Loan (in planning).

This project will improve thermal efficiency at a power plant.

Hungary

SAL Structural Adjustment Loan II ($250 million/June 1991).

Energy related conditionality included energy price reform.

Energy/Environment Project (approximately $125 million/spring 1993).

Focused on increasing natural gas supply, energy conservation, and environmental protection.

SOURCE: Bernard Montfort and Harold **E. Wackman, "The World Bank Support for Energy Sector Transformation in Central and Eastern Europe" World Bank, July 1992).**

energy efficiency issues at the early stages of the Bank's country policy dialogue, greater use of demand side management planning, and increased transfer of energy saving technology within sector and project work. The Energy Sector Management Assistance Program (ESMAP), a joint program of the World Bank and the U.N. Development Programme (UNDP) that undertakes energy assessments of member countries and provides follow-up technical assistance, has been integrated more closely into Bank operations, and can provide support for institutional design, pricing policy, and regulatory issues in establishing an energy conservation strategy.[61] Other programs that could have a greater influence on Bank energy efficiency

61 Energy Sector Management Assistance Programme (ESMAP), ''ESMAP: A Briefing Note, ' September 1992, and "Energy and the Environment: ESMAP Beyond UNCED, " October 1992.

lending include the Financing Energy Services for Small-Scale Energy Users (FINESSE) program, begun in 1989 to provide financing for small energy loans, and IFREEE, which can support energy efficiency experts to assist in the design and financing of Bank projects.

The International Finance Corp. (IFC), the private sector lending arm of the World Bank Group, raises its share capital from member countries but provides loans and equity on strictly commercial rates. The IFC is also an implementing agency for the Global Environment Facility (GEF), discussed below, and is assisting in developing a GEF private sector program.

The IFC's activities in Central and Eastern Europe have focused on providing technical support and financing for the privatization, restructuring, and modernization of state enterprises. A number of these enterprises are in energy-intensive industries-cement, glass, rail transport-or in energy products—lighting, insulation. In Poland, the IFC cofinanced the purchase of a manufacturer of lighting products by Philips, which will now produce energy-efficient lamps.[62]

It has been proposed that the IFC integrate energy efficiency into its operations by providing technical assistance to firms and by conditioning financial assistance on energy audits.[63] These functions could be provided by the IFC's Technical and Environment Department, which currently conducts environmental impact assessments and promotes private sector involvement in environmental industries.

The World Bank Group also provides insurance for foreign investment through the Multilateral Investment Guarantee Agency (MIGA), which was established in 1988. MIGA also provides technical and advisory assistance to create appropriate settings and programs for investment. Most countries in Central and Eastern Europe have become members of MIGA or are in the process of doing so. Through its Foreign Investment Advisory Service, MIGA has assessed investment incentives in several Central European countries.[64]

The Global Environmental Facility

The GEF was established in 1990 to finance energy and environmental projects that could show global environmental benefits but would not otherwise be commercially viable. Investment projects are implemented by the World Bank, technical assistance and research by the UNDP, and scientific research by UNEP. In its pilot phase, from 1990-93, the GEF has provided funding for investment and technical assistance in four areas: global warming, biodiversity, international waters, and ozone depletion. For the pilot phase, the GEF has pledges of about $1.2 billion, which includes $200 million of cofinancing and $150 million from the United States of parallel financing.[65] A number of energy projects have been approved, primarily in the area of renewable energy. Energy efficiency projects are under consideration in the second and third phases of the GEF work program.

At the U.N. Conference on Environment and Development (UNCED) in June 1992, it was agreed that the GEF would move beyond the pilot phase and act as the interim financial mechanism for the Framework Convention on Climate Change. This will make the GEF a major potential source of financing for energy efficiency projects. In collaboration with the IFC, the GEF has also

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62 IFC, *Annual Report 1992*; IFC, *IFC and the Environment: Annual Review 1992* (Washington, DC, 1992).

63 Phillips, *The Least Cost Energy Path for Developing Countries*, supra note 59, p. 85.

64 As of Oct. 30, 1992, Poland, Hungary, the Czech and Slovak Republics, Estonia and Azerbaijan were members of MIGA; the Russian Federation and most other Newly Independent States are in the process of fulfilling membership requirements. Multilateral Investment Guarantee Agency, *Annual Report 1992.*

65 Global Environment Facility, "Report by the Chairman to the April 1992 Participant's Meeting: Part One, Main Report," March 1992, p. 13.

been working on increasing private sector access to its funds.

The European Bank for Reconstruction and Development

The EBRD was formed by the United States and the EC to assist in the development of market economies and democratic systems in Central Eastern Europe. The Bank began operations in April 1991 and is both a development bank and a merchant bank: 60 percent of its funding must be to the private sector, with not more than 40 percent to public infrastructure or other projects. Its lending was $353 million in 1991 and is estimated to be $930 million in 1992. The United States has been the largest single donor to the Bank, contributing 10 percent of its capital stock (the U.S. contribution in 1991 was $70 million). The EBRD currently plans to earmark 60 percent of its loans for Central Europe and the Baltics and 40 percent for the NIS.[66]

The EBRD has cofinanced an energy sector loan in Poland with the World Bank and has several other energy projects in its "pipeline," including emergency energy loans to the Baltic states[67] and developing, with AID assistance, energy service company joint ventures. The EBRD's ''Energy Operations Policy, ' completed in May 1992, states that the Bank's "overall objective will be to assist countries to reorient sector development away from a narrow focus on supply expansion to a broader 'least-cost' focus. . .in which projects to expand supplies are compared with alternatives to improve supply and end-use efficiencies. But the stated near-term priorities are heavily in conventional energy supply projects: repairing and rehabilitating existing supply facilities, completing existing power sector projects, assisting counties in diversifying energy supply, and promoting private sector projects which ''promote liberalization of supply. ' The Bank concludes that ''the majority of operations are expected to provide finance to fuel industries and energy utilities. "[68]

The European Energy Charter

The European Energy Charter is a political declaration of principles, objectives, and actions that aims to create a new framework for cooperation, investment, and trade in energy across Europe and possibly across the world. The Charter was initiated by the EC with the major objective of integrating Central and Eastern Europe into world energy markets. Following several months of preparation, it was signed by 43 countries, including the United States, in December 1991, and several others since then. A legally binding "Basic Agreement" to the charter and additional protocols are currently under negotiation.[69]

The Charter's objectives are organized around three functional areas: energy trade, international cooperation in the energy field, and energy efficiency and environmental protection. The first two of these include provisions to promote sounder legal frameworks for energy activities, access to energy resources, lower barriers to trade in energy goods and services, efficient management and use of energy resources, modernization of infrastructure, information exchanges, research and development, and policy consultation.[70]

The objectives for energy efficiency and environmental protection include:

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66 European Bank for Reconstruction and Development, *organization,* March 1992.

67 uropean Bank for Reconstruction and Development, *Procurement Opportunities,* No. 5, August 1992.

68 Document of the European Bank for Reconstruction and Development, ' 'Energy Operations Policy, ' March 1992, pp. 2-6.

69 Richard Greenwood, ''The European Energy Charter: A new framework for pan. European energy cooperation,'' *Energy in Europe,* No. *19,* July *1992, pp. 69-72.*

70 ''Concluding *Document* of the Hague Conference on The European Energy Charter, ' Dec. 16-17, 1991, The Hague, Netherlands.

- ensuring, in a cost-effective manner, consistency between relevant energy policies and environmental agreements and conventions;
- ensuring market-oriented price formation, including a fuller reflection of environmental costs and benefits;
- the use of transparent and equitable market-based instruments designed to achieve energy objectives and reduce environmental problems;
- the creation of framework conditions for the exchange of know-how regarding environmentally sound energy technologies and efficiency use of energy; and
- the creation of framework conditions for profitable investment in energy efficiency projects.

Negotiations over the "Basic Agreement," that would provide a legal framework for energy trade and investment, and more detailed sector protocols—initially energy efficiency, nuclear power, and hydrocarbons-began in February 1992. The negotiations over the Basic Agreement, planned for completion by December 1992, have proven more difficult than expected and are anticipated to last into 1993.

Other Multilateral Programs

A number of other multilateral organizations are supporting energy efficiency research and measures. The IEA, which normally confines its research to OECD member countries, has carried out energy assessments of Poland (1991) and Hungary (1992) and recommended a series of energy efficiency steps.[71] The IEA also has programs of energy technology research and development and demonstration and information sharing that are being slowly opened to participation by Central and Eastern European countries. For example, the IEA Center for the Analysis and Dissemination of Demonstrated Energy Technologies (CADDET) provides information about new energy technologies.

The UN ECE energy efficiency program for Europe, Energy Efficiency 2000, was launched in mid-1991, and included a particular emphasis on assistance to Central and Eastern Europe.[72] The objectives of the program include promotion of trade, dissemination of information, technology assessments, and development of "demonstration zones" and pilot projects. Major undertakings have included a number of international meetings and trade fairs .73 The UN ECE and the UNDP have also recently established the Eastern European Center for Energy Efficiency in Buildings in Sofia, Bulgaria. The center will assist in information exchange, training and promotion of building energy efficiency projects.

EUROPEAN AND JAPANESE PROGRAMS

European countries are very active in reforming the energy system in Central and Eastern Europe, both through the EC and on a bilateral basis. The EC is attempting to lay the foundation for a common European energy system with programs of policy and technical assistance, capacity building through a series of energy centers, and the European Energy Charter. Often supported by bilateral energy cooperation agreements, European firms, particularly from Germany and Scandinavia, have also been developing business opportunities in the energy sector

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71 The IEA was established within the Organization for Economic Cooperation and Development (OECD) in 1974 (following the first oil crisis) to coordinate an international energy program focused on the stability of oil markets and steps that countries can take to reduce oil dependence, including energy conservation. IEA/OECD, *Poland: Energy Policies, 1990 Survey* (Paris, 1991); IEA/OECD, *Hungary: Energy Policies*, 1991 Survey (Paris, 1992).

72 The U.N. Economic Commission for Europe was created by the U.N. Economic and Social Council in 1947 to promote economic relations in the region. The United States is represented on the Commission.

73 U.N. Economic Commission for Europe, *East-West Energy Efficiency*, ECE Emergu Series No. 10 (United Nations: New York, 1992), p. 48.

and in energy efficiency. European firms obviously have a geographic advantage over U.S. fins, and more consistent governmental and commercial relations. Several European countries and Japan also offer export promotion and financing in greater quantities and on better terms than the United States.[74]

A discussion of specific EC and Japanese projects and funding will be provided in the final report of this study.

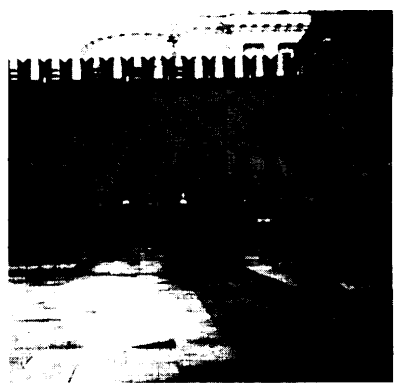
[74] Office of *Technology* Assessment, *Competing Economies: America, Europe, and the Pacific Rim.* A forthcoming OTA study on U.S. environmental technologies and competitiveness will compare U.S. with Japanese and European trade promotion activities in the environmental and renewable energy sectors.

Policy Considerations 6

The countries of Central and Eastern Europe all have energy problems, some extremely serious, as has been described in the previous chapters. The problem is not a lack of regional resources, but economic and political disruption. Even in energy producing countries such as Russia, energy shortages have become a constraint on economic activities. Some problems can be corrected by these countries themselves or could be alleviated by overall economic reform (e.g., ending subsidies of energy prices that encourage waste). As market prices and incentives improve decision making, and obsolete manufacturing facilities are replaced, energy efficiency will rise. However, that presumes they will successfully navigate the transition.

The process of raising energy efficiency can be greatly accelerated by technology transfer from the West, thereby contributing substantially to the transition. The notable gains in efficiency in the United States since 1973 came from myriad technological improvements, many of which can be transferred to these countries. In a few years, energy savings could far exceed direct financial assistance from the West and help finance overall economic revitalization.

Assistance in increasing energy efficiency could return several benefits to the United States. First, improving energy efficiency appears to be one of the most cost-effective contributions to economic revitalization. There is a clear U.S. national interest in promoting revitalization because the present economic chaos could lead to security concerns if hostile, authoritarian regimes emerge. It is likely that savings in the U.S. defense budget from the end of the cold war will be small if economic reforms fail in the former Soviet Union (FSU). Second, some of the energy saved will be available on the world oil market (and some very



Joanne M. Sador

The Kremlin Wall by Lenin's tomb.

Box 8-A-Example of U.S. Benefit From Energy Efficiency Assistance

If the **petroleum consumption of the former East Bloc (about 10.5 million barrels/day (MMB/D) in 1989) is reduced sufficiently to expand exports by 1 MMD/D,** world oil supplies (out side the former Bloc) effectively would increase by about 4 percent Such an increase might decrease world prices about 3 percent (the actual number would vary with time and the outcome of many variables including the behavior of other exporters and importers; this is an estimated composite). Since the United States imports about 7 MMB/D which now cost $20/barrel, savings would be $1.5 billion/year. These savings would continue **until the facilities or equipment to which the improvements are made are replaced, probably at least a decade on the average.**

Estimates of what it would cost to achieve these savings are very uncertain, but the total would be about **$7 billion total if, as appears likely, sufficient opportunities to save this much energy are available with one year payback For example, the United States could supply a combustion control system and other equipment costing $200,000 to a factory in Eastern Europe that saves 10,000 barrels of oil per year, worth $200,000. If a total of $7** billion was supplied to save energy, the nations of Central and Eastern Europe would save $7 billion/year. The United States would save $1.5 billion/year, recouping its investment within 5 years **and** continuing to enjoy the dividends for many more. However, not all oil saved will be exported. Some of the savings will allow very expensive or high-sulfur oil to be left in the ground. Therefore, additional efficiency gains must be **attained to achieve 1** MMB/D additional exports. Countering this factor are the contributions of other countries, particularity in Western Europe. The United States need supply only its share, not the entire remedy. All importers benefit from lower prices not matter what the source.

Price decreases normally lead to consumption increases, which could negate the advantage. That need not happen if an energy tax such as on gasoline, imported oil, carbon, or general energy was imposed to raise the price to consumers. This combination of tax plus increased assistance would capture economic advantages for the nation without encouraging increased imports of oil. It would, however, come at the expense of oil exporting countries, including U.S. allies such as Mexico and Venezuela.

This simplistic calculation is only indicative, not predictive, but it shows that the benefits to the United States of energy efficiency assistance to Eastern Europe could be very large even without counting indirect benefits such as increased stability and trade, and an improved environment.

SOURCE: U.S. Congress, Office of Technology Assessment, 1993.

expensive or dirty fuel will simply not be produced), keeping prices lower than they otherwise would be. As a major oil importer, U.S. economic savings could be substantial (see box 6-A).

Third, energy is one of the major sources of pollution in Central and Eastern Europe and there will be major environmental benefits from reducing consumption. In particular, improved energy efficiency in this region may well be the most cost-effective way to reduce emissions of carbon dioxide, the main concern for global climate change.

Efforts to assist Central and Eastern Europe must be shaped by the urgency of the political and economic crises facing these countries, caution because of the complexity of the situation, and recognition that the United States can supply only a small fraction of the help that is needed. The outcome of reform efforts for many of these nations is very uncertain. The reforms may succeed, resulting in friendly, productive trading partners. They may fail catastrophically, resulting in total chaos and great human suffering. Or they may be terminated violently by new, authoritarian leaders. The latter two prospects are likely to be far more expensive for the United States than even a massive aid program. Western involvement may well be crucial in averting disaster in this region.

Table 6-l—Policy Options To Promote Technology Transfer

Increase Funding for Energy Assistance
Information programs-policy assistance and technical assistance.
Material support-purchase equipment and support private investment.
Reorganize Assistance Programs
Rationalize procurement policies
Review "Buy-Ameria" policy
Re-organize for efficient cooperation
Investment and Export Assistance
Expand TDP and AID feasibility studies
Institute insurance for economic risks
Support CORECT
Export-Import Bank assistance for small companies
Expand FCS and other assistance programs
Training and Education Programs
Ensure all assistance programs include training when feasible.
Establish programs to bring trainees to the **U.S.**
Encourage university programs
Train energy analysts directly.
Create **a** legislative energy policy course for parliamentarians.
Federal Agency Cooperation
Increase DOE and EIA roles in advising governments.
Support Federal and State regulatory agency advice programs.
Collaborate in R&D efforts.
International Assistance Programs
Encourage multinational agencies to give higher priority to efficiency.

SOURCE: U.S. Congress, Office of Technology Assessment, 1993.

However, it is clear that the impact of U.S. aid will be small unless the nations of Eastern Europe provide the conditions to make assistance useful. Most technology transfer and foreign investment will be from private enterprise. Much is now deterred by political and institutional instability, uncertain legal requirements, punitive taxation, and other problems. Some nations are actively addressing these problems, others have barely started. U.S. Government technical assistance must be targeted to where it can be used most effectively. There is little point in trying to improve the energy efficiency of enterprises that have no market incentives to improve themselves. Greater energy assistance can have major benefits, but only if **carefully directed.**

The previous chapter discussed the programs that have already been initiated. Most of these programs involve technology transfer, usually in the form of information (e.g., policy advice, access to databases), specific technical assistance (training, energy audits), and material (financial assistance to procure equipment). This chapter suggests how these programs might be strengthened and the potential results if they are. A recent OTA report[1] on energy in developing countries has further information on the agencies and institutions involved. The nations of Central and Eastern Europe are technologically, economically, and socially quite different from developing countries. Nevertheless, the mechanisms for expediting technology transfer and supplying foreign assistance are largely the same, and much of the policy discussion in that report is relevant here.

The major areas to consider are shown in table 6-1 and discussed below.

U.S. POLICY OPTIONS TO INCREASE TECHNOLOGY TRANSFER

I Increase Funding for Energy Assistance

The current level of foreign assistance funding for Central and Eastern Europe is substantial, as discussed in the previous chapter. Nevertheless, far more assistance could be used effectively and may be essential in avoiding disintegration of some states. It is not the intent of this section to analyze where the additional funds would come from. However, the budget deficit is inescapable, so it is worth noting that there are only three options:

1. The overall foreign aid budget could be increased, putting further pressure on the deficit;
2. Funds could be redirected from other regions of the world, further reducing already diminished programs in developing countries that may need assistance even more desperately;

[1] U.S. Congress, Office of Technology Assessment *Fueling Development: Energy Technologies for Developing Countries*, *OTA-E-516 (Washington* DC: U.S. Government Printing Office, April 1992).

3. Energy efficiency projects could be given a higher priority for the funds already earmarked to Central and Eastern Europe. However, the needs are so great across the region and across these economies that it is difficult to argue that energy efficiency is necessarily such a high priority.

All three of these options involve major liabilities, yet the need for the funds is also very great. Congress will have to balance some very important national goals in considering this issue.

Several of the following sections discuss specific areas where funding increases may be warranted. This section is an overview of what might be done for energy efficiency if an overall increase is seen as in the national interest. Two general areas should be considered to accelerate energy-efficiency technology transfer: increases in programs involving the transfer of information, and increased support for investment and the purchase of equipment.

INFORMATION

Unlike developing countries, Eastern Europe has substantial technical capabilities. The main reason that efficiency is so low is because the system provided no incentive to minimize costs, not because decisionmakers couldn't have figured out how to do it had that been their goal. Now, even though elements of the market are being introduced, it will take a long time before the incentives are completely in place. Decisionmakers must learn how to react to them and become acquainted with opportunities to do so. Energy-efficiency information programs are intended to accelerate the latter two shifts. Policy assistance improves the understanding of decisionmakers, while technical assistance provides the necessary skills and data at the local level.

Policy assistance is rendered primarily by the Agency for International Development (AID) and the Department of Energy (DOE) through the Regional Energy Efficiency Project, in particular the Energy Pricing, Energy Efficiency, and Energy Restructuring component ($6.4 million, which includes technical assistance). Increases in energy-policy assistance would logically come from the same agencies, plus perhaps the Environmental Protection Agency, through information exchanges, visits, and other contacts. Enhanced contacts are discussed below in the section on Federal Agency Cooperation. Generally, this need not be a very costly nor long-term program. However, increased funding would accelerate the growth of expertise needed for energy system market reforms.

Technical assistance encompasses a variety of activities including the promising centers for energy efficiency. These appear to be well received in the areas they are starting to serve, and expanding the concept could be considered. The United States has sponsored centers in Prague, Warsaw (with an office in Katowice), and Moscow, and another is being created in Sofia, Bulgaria. Others could be initiated in Ukraine, Belarus, Hungary, and elsewhere. Since these centers employ primarily local people, care has to be taken to ensure that the proper expertise and support are available. These centers could lose credibility if they are expanded too rapidly. However, they also appear to be among the most effective forms of U.S. assistance, and if additional finds can be supplied, centers should be a high priority. The centers are funded by AID through DOE.

Another activity that could be effectively expanded is for demonstrations of technologies unfamiliar in eastern Europe. Techniques such as combustion control, waste heat recovery, energy management systems, and power systems monitoring are well know in the West but not in Eastern Europe. Before plant managers commit to making changes, they will want to be sure that changes are worthwhile. Demonstrations have been important in this country to accelerate penetration of new technologies. They will be even more important in eastern Europe where the whole concept of innovation to reduce costs is new. For example, several combustion control systems have been installed on boilers in factories

and district heating plants. The results have surprised the operators who had no idea how cheap and easy it is to save energy.[2]

AID's industrial audit program already includes some demonstrations. It could be expanded to include a greater emphasis on the installation of energy-saving equipment, with follow-up monitoring and information programs for other facilities with similar needs. The audit program itself could also be expanded to Russia and other FSU nations.

The third area of technical assistance that appears to be particularly appropriate for expansion is *training*, such as for energy managers and auditors. This is discussed below under training and education programs.

Adding several million dollars to the Energy Pricing, Energy Efficiency and Energy Restructuring component would significantly increase the value of these programs. More might be required if many demonstration projects are desired. Such a strong program would help build relationships among U.S. companies and new customers, leading to longterm commercial benefits.

MATERIAL ASSISTANCE

The second general area for increased assistance, support for investment and purchases, would be more expensive, though results could be commensurate and there would be considerable benefit to U.S. companies. Lack of money is one of the greatest barriers to improved efficiency as these nations introduce market economies. In many cases, managers know what should be done, but they simply can't afford to do it. Making additional funds available for enterprises to purchase new equipment, revamp energy intensive production lines, upgrade buildings and heating systems, and increase production of energy-efficient equipment would be the most effective thing the U.S. Government could do. Clearly, there are far more opportunities for funds to be productively spent than are likely to be funds available. Nevertheless, any increase, if targeted appropriately (see below), would be useful.

The major approach to assisting directly in improving energy efficiency is through AID. AID could expand its assistance with the purchase and installation of the equipment recommended in its energy audits of industrial facilities and district heating plants. Such a program would be similar but much larger than the demonstration program discussed above. Results should be significant because in many cases, without assistance, the improvements will not be made. In addition, AID could supply the expensive instrumentation needed for sophisticated energy audits. Training in audits does little good if the auditing team cannot afford the means to perform the work.

Naturally, there will be considerable pressure to buy American equipment under such a program. However, OTA has heard reports that this approach sometimes has failed because the American supplier has not had adequate service representation in eastern Europe, or because American equipment was not appropriate for the task. This problem is discussed in the following section.

Another cautionary note is that it is necessary to be careful about who receives the funds. Supporting bankrupt facilities will accomplish little. In countries where implementation of market incentives is lagging, central ministries may not make good use of assistance. Funding for energy efficiency must be targeted directly to where it can be used effectively.

Other programs to support exports and investment overseas are discussed in the section below on export assistance. These are not primarily foreign assistance programs.

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2 Michael Ellis, "Energy Efficient Technologies and Methods in Industries: USAID Industrial Energy Efficiency Program in Lithuania," paper delivered by Mark Hanson at a conference ''Lmproved Energy Efficiency in Former Centrally-Planned Economies, ' Kaunas, Lithuania, Oct. 19-21, 1992.

| Reorganize Assistance Programs

Much of the U.S. program for assistance to Central and Eastern Europe has been well-planned and has produced encouraging results. However, there also is some evidence that operations could be more effective. The strategic planning for assistance to Central and Eastern Europe appears to be inadequate. Aside from the G-7 agreements, no one has determined how much aid is required and the most effective way to deliver it. Even within AID, responsibility is divided among several divisions, and intergroup communications appear to be less than complete. There appears to be ample opportunity to streamline the programs, although that is beyond the scope of this assessment.

A common operational complaint is that procurements are too cumbersome, in large part because they seem burdened with excessive safeguards to ensure fairness and honesty. While these are certainly laudable goals, rigid application of tight controls, especially where the controls are not appropriate, can result in virtual paralysis. For example, staffing for the energy efficiency centers was delayed because of a requirement for proof that the salaries to be paid were comparable to those for similar jobs. It is almost impossible to determine comparability during the economic turmoil that exists now, but getting the requirement waived was very difficult. No one seems to have the authority or the incentive to restrict the review to those regulations that make sense for a particular procurement.[3]

The procurement process also deters potential contractors who may have the expertise or products needed but who lack the resources to learn the system. The net effect, at least for AID procurement, is a concentration on familiar contractors who know how to navigate the process. For example, the specialized energy auditors who analyze U.S. industrial facilities feel shut out of the AID process. Contracts are often large and cover many separate tasks. Small contractors are unable to respond even if they find out about the opportunity, and don't have the resources to persevere through the contracting process. If the audits are to be expanded past the current basic stage, it will become increasingly important to tap this specialized expertise.


Larry Markel

U.S. advisors training Polish technicians in weatherization techniques.

Nonprofit institutions also find the process formidable. For example, a consortium of environmental organizations led by the Natural Resources Defense Council has proposed an energy efficiency program, involving training and assistance in developing integrated resource planning (IRP) concepts in the North Caucasus region of Russia. The idea appears worth considering, but the group has had difficulty applying for funding

[3] This was a recurrent theme of the OTA workshop on Sept. 18, 1992 and in the ''Report of the Task Force on Foreign Assistance' to the Committee on Foreign Affairs, U.S. House of Representatives, Document 101-32, Government Printing Office, February 1989.

because it does not fit neatly into any existing activity.

Some of the problems encountered are generic to the U.S. Government, rather than specific to AID. Congress might consider whether all the accountability and other requirements imposed on government agencies are taking an excessive toll in governmental efficiency and creativity. An evaluation of procurement practices and reform is well beyond the scope of this study. However, three modest steps to expedite the process would be particularly relevant to Central and Eastern Europe. First, quite frequently only one or two local contractors are qualified (especially since command of English is one of the necessary qualifications). Simply easing the standards for sole source procurement would facilitate contracting with little or no loss of competition. Second, a small portion of the funding could be exempted from some of the controls to encourage agencies to experiment with unorthodox approaches and creative ideas. The energy efficiency centers were not initiated through an AID plan, but because outsiders, working through DOE, were able to make the case they were needed and persevere through the process of securing funding.

Third, finds now transferred from AID to another agency could be appropriated directly. In particular, the energy efficiency centers are paid for by AID through DOE, because of the latter's expertise on the subject. The Environmental Protection Agency also receives funds from AID for various programs. Centralizing the appropriations helps to coordinate activities, especially when the activities are in a state of flux. However, if a specific item is likely to receive funds for a period of years (such as expanding the number of energy efficiency centers), appropriating the money directly to the disbursing agency would save a step that requires time and effort.

Another issue has been pressure to spend funds in this country rather than transferring them to the recipient country. Up to a point, such a practice is both necessary and reasonable, and all donor countries engage in it to some extent. It would be hard to justify spending our funds for equipment supplied by our trade competitors. However, as noted in the previous section, American equipment can also be useless equipment if it fails and cannot be serviced. In the long run, this damages American interests and wastes assistance.

Overemphasis on ''Buy American" can also conflict with the SEED Act, which seeks to build up the capabilities of Central and Eastern Europe. If, as assumed in this report, the object of aid is economic revitalization, then the latter must have priority. Aid that does not promote development will have very limited results. The old adage that you can feed a man for a day if you give him a fish, but he can feed himself for life if you give him a fishing rod has a modern counterpart. Sending an American team to install a combustion control system on a boiler in Moscow will save energy for that facility. Helping a local enterprise design and build control systems, and training energy engineers in how to use them, will create a flourishing business and help many facilities save energy. The impact of aid that conveys new capabilities, i.e., technology transfer, will continue to grow far beyond the ability of the West to give goods and services.

Naturally, there must be a balance. Giving business to American companies is very often appropriate. Training and demonstrations accompanying American equipment and services can be very effective technology transfer. However, the desire to help American companies should not conflict with the basic mission of the aid program, which is to help other countries develop. In the long run, development will contribute far more to the U.S. national interest. The difficulty appears to arise not in the legislation[4] but in policies carrying out the law.

4< 'Buy American Act of 1988, ' Title VII of Public Law 100-418.

| Investment and Export Assistance

The greatest strides toward development and energy efficiency will come with new industrial and commercial facilities. However, none of the nations of Central and Eastern Europe have the capital to build many new facilities. Western companies are likely to be the key to overcoming this barrier to development, through investments in productive facilities. Manufacturing facilities there generally are in great need of upgrading to produce appropriate, modem products while reducing pollution. Not only do such investments directly provide needed facilities, but they also facilitate technology transfer for further development. Large companies are accustomed to investing in many countries in expectation of earning a profit, at least eventually.

Relatively little investment by American companies has taken place yet, in part because of the economic turmoil surrounding the transitions underway, compounded by soft markets at home. Many American companies also seem to lack the staying power of European and Japanese competitors in building a base for the long term. Small companies are particularly deterred by lengthy negotiations, legal and institutional uncertainties, and the high cost of visits. If building economic health in eastern Europe is seen to be in the U.S. national interest, then additional efforts to promote investment are likely to be required. Promotion is likely to be important in ensuring that U.S. companies develop a strong presence and maintain competitiveness relative to European companies which are much closer geographically. Such efforts might involve financial incentives from the U.S. Government to build in the region. However, great care must be taken to ensure that the program will help create new demand, not transplant American jobs abroad.

U.S. AID



A computer in the central control room of a pharmaceutical plant in Prague.

Another cause of the reticence of American companies to invest is the risk involved. The Overseas Private Investment Corp. (OPIC) insures against political risk, such as expropriation. Commercial insurance also is available for some economic risks. However, small enterprises, such as some in this country that invest in energy efficiency projects with industry and share the savings, may feel too exposed in eastern Europe. Many enterprises there will go bankrupt, leaving investments stranded, and it can be difficult to determine which ones are vulnerable. Partnerships to share energy savings could be effective ways to promote energy efficiency if ways can be found to reduce this risk. One suggested way is through an additional insurance plan that would be based on extensive analysis of the prospects of the industrial facilities and on the U.S. national interest in promoting energy efficiency. Such a plan might be initiated by OPIC. An alternative approach would be additional financing by the U.S. Government, which would share the risk.

The programs discussed in the previous chapter appear to be effective, and could be usefully expanded. Feasibility studies, such as supported by AID and the Trade and Development Agency (TDA) frequently lead to the purchase of American equipment and supplies. These studies are not very expensive and may return many times their cost in business. However, most of the energy

studies to date have been supply, not efficiency oriented.

The Committee on Energy Efficiency Commerce and Trade (COEECT), an interagency coordination body modeled on CORECT (Committee on Renewable Energy Commerce and Trade) relies on industry input to identify U.S. Government assistance necessary to increase U.S. exports and technology transfer in various world markets. CORECT currently is being formed with fiscal year 1993 appropriations.

Two factors suggest that attention to the Export-Import Bank (Eximbank) may help to increase sales of energy-efficiency products. First, most support for exports at present is for energy supply projects because they usually are large transactions that are compatible with conventional procedures. Greater efforts may be required to convince the efficiency industry to look for exports and Eximbank to emphasize those exports. Second, energy-efficiency products often are produced by small companies unfamiliar with Eximbank services, which are geared to larger companies. Exim's new Small Business Set Aside Program should alleviate that problem, but Congress may want to monitor its activities to ensure it. In addition, agreements must still be reached with the remaining countries in the region to make them eligible for Eximbank loans.

As has been noted several times, the lack of funds, especially hard currency, has prevented badly needed investment and purchase of equipment. Financing can be the key to increased U.S. exports. The enterprise funds discussed in the previous chapter have the potential to be major contributors, but as yet have little experience with energy efficiency. Total financing may have to be in the range of many billions of dollars to both support the competitiveness of U.S. companies and provide the needed investment for Central and Eastern Europe. Energy should receive a reasonable share of the total, but it may be necessary to stipulate that energy-efficiency projects get special handling.

Commercial sales of equipment services could benefit from a more aggressive government policy. Sales of energy-efficient equipment and techniques could become large. However, many of the leading American companies in the field are small and need assistance to realize their potential. Expansion of the Small Business Administration's Export Revolving Line of Credit could be the key for many small companies, especially if combined with information on how to do business in the region. Small businesses are frequently unaware of information and other services provided by the Department of Commerce (DOC), the Foreign Commercial Service (FCS) and sometimes AID, Greater outreach, including notification of opportunities, trade missions, data collection, and other promotional activities can make it possible for American companies to market where otherwise they would find logistics too difficult. AID contacts have already led to significant sales as noted in chapter 4, even though that is not the main function of the assistance programs.

Training and Education Programs

All the nations considered in this analysis have well-educated work forces. In fact, the fraction of the population with a technical education is higher than in many western countries, including the United States. What they are missing is expertise important in a market economy, e.g., energy and financial analysis; management, including an understanding of the importance of minimizing costs; and specific information on opportunities to do so. At the factory level, many engineers, managers and other personnel can quickly absorb this information. Thus training programs can be very cost-effective ways to accelerate efficiency.

For example, OTA has heard from both Americans and Eastern Europeans that some industrial facility auditors performed their analysis by themselves, wrote up their recommendations, and left. Such limited contact may leave the facility

personnel with a general idea of what an audit is, but at best it provides a one-time improvement. The exercises that included training in the detailed techniques of energy auditing and the necessary instruments allowed plant personnel to follow-up with continuing improvements and ensure that new equipment was working as predicted. There is a need for expanded training for the emerging private consultants as well as for the industry plant personnel directly involved in managing energy to assure that the skills are developed and energy-efficiency work continues in these countries.

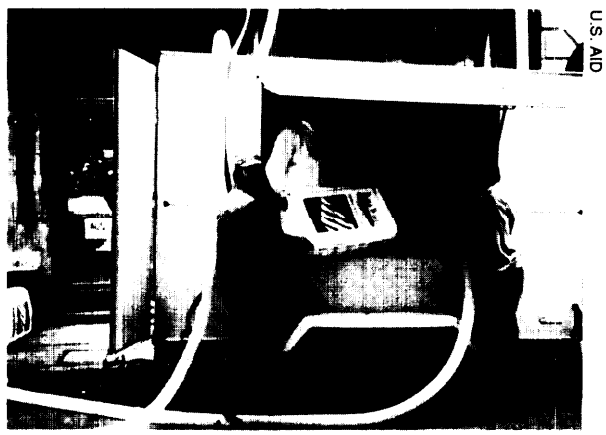
Another possibility would be to augment programs bringing East Europeans to this country to study modem energy management. AID and various private institutions already have related activities. Cooperative work/study programs in industry and academia could be arranged with a focus on energy. This approach would provide total immersion in modem industrial practices, including technology, quality control, innovation, marketing, and management methods. This approach can be a very effective form of technology transfer, conveying critically needed skills.

The nations of Central and Eastern Europe are also deficient in broadly trained energy analysts, including data collection and policy analysis. Many people have a relevant technical background and can be easily retrained to understand how energy markets work and the national implications of various decisions. Ensuring that energy ministries have access to this expertise should help put demand options on an equal footing with supply. AID activities under the Regional Energy Efficiency Project could be expanded to include the transfer of this expertise, perhaps with the cooperation of DOE and the Energy Information Administration

The energy efficiency centers provide training (including training of trainers) and policy consultation to governments. Expanding their activities would be one way to contribute to the growth of this expertise. One form of training is with retired Americans who visit the centers for a period to share their expertise.

Various non-Federal Government initiatives also could be supported to increase training. For example, many large cities in Central and Eastern Europe have sister city connections in the United States. Many American cities have implemented energy saving programs, especially in low income housing. DOE has been involved in these programs and could be funded to help local governments transfer this experience. DOE and AID also have sponsored a sister utility project which is transferring expertise on electric power operations. Many American utilities have extensive programs to help their customers conserve energy in order to avoid having to build new powerplants. Transferring this type of information could be accorded a higher priority, which would expedite energy efficiency and allow the shutdown of particularly polluting or dangerous powerplants.

It is worthwhile to note that very few students from the FSU are enrolled in American universities. In contrast, China has had tens of thousands of students here, most of them in science and engineering. Government/private programs to bring Eastern European science and engineering students here would be one of the most effective



Polish technicians with insulation blowing machine supplied by U.S. AID.

forms of technology transfer, though the effect would not be noticeable for a decade or more. Similarly, there is no Russian equivalent to the Dalien Management Institute in China, a school that teaches modem management using visiting American professors. It is sponsored in part by DOC and has been playing an increasingly important role in China's surging economy. DOC could fund such schools in Eastern Europe.

Congress plays a direct role by sharing expertise on legislative activities and support services with the parliaments of Eastern Europe. This program could be expanded to include detailed information on energy. That would be particularly pertinent because of the major legislation[5] that was enacted in 1992. The negotiation process that achieved balance among the various perspectives, interests, and options would be of great interest to many parliamentarians involved in energy policy. Operations in a parliamentarian form of government are quite different from the American model, but many of the considerations that go into legislation are common. Congress could invite members of the various parliaments, senior staff, university professors and others to spend several months here, working with committee staffs and support agencies. This program might have to include travel and per diem expenses because of the severe economic problems in Eastern Europe, so the total cost might be on the order of $5,000 to $15,000 per visitor, depending on the length of stay, plus the staff time that would be involved. Existing private programs such as in universities and other institutions might cooperate with this activity.

Federal Agency Cooperation

The sophistication of our understanding of key energy issues (e.g., the role energy plays in the U.S. economy; how to maximize its benefits to the country and minimize its problems) has grown considerably over the past 20 years. Making DOE's expertise on energy issues and technology more available (e.g., attending conferences, assisting ministries) could convey substantial advantages. Many governments appear not to understand how much energy their economies waste, how much that costs them, or what to do about it. DOE plays a role in Eastern Europe, but it is largely secondary to AID. As noted above, DOE/EIA training programs for counterparts in Eastern Europe should strengthen energy policy decisionmaking. A direct role by DOE advising and training government officials could go even further.

For example, poor energy data is an obvious deficiency that makes analysis and policy making quite uncertain. It is impossible to determine the best allocation of limited funds for investment when you have very limited understanding of the costs and benefits you are trying to adjust. EIA collects and analyzes vast quantities of information. They could transfer their expertise in knowing what data are critical, how to collect it with minimum disruption, and how to prepare it for use by policymakers. This could be done by extended visits in both directions,

Another potential area for cooperation is regulation. The Federal Energy Regulatory Commission and various State regulatory agencies should have much to offer in determining equitable rate making for electricity and natural gas. In addition, State agencies are pioneering energy planning, including IRP. At present, electric power companies in Central and Eastern Europe have little need for IRP because they have excess capacity, but the planning concepts should become more useful as their economies stabilize. State agencies could assist in determining what would work and how to initiate it.

A third possibility is for shared R&D projects in energy efficiency. Funding projects there would help direct attention to efficiency opportunities as well as expand those opportunities. Such

[5] The Energy Policy Act of 1992, PL 102-486, made great changes in many aspects in an attempt to make the energy system, both supply and demand, work more effectively.

a program would capitalize on the low labor costs due to the collapse of the ruble and other currencies, and might yield substantial benefits here if the R&D is successful. Some collaborative efforts already have been initiated, such as with fusion R&D. DOE's proposed ADEPT program (Assisting Development of Energy Practices and Technology) could be an appropriate mechanism.

Raise Priority of Energy Efficiency Among Multilateral Agencies

The multilateral development banks (MDB) such as the World Bank and the more recent European Bank for Reconstruction and Development (EBRD) tend to focus mainly on large energy supply projects.[6] Projects to improve energy efficiency usually are small and dispersed (an exception is entirely new manufacturing facilities where high efficiency is designed in as only one of the benefits), and are harder to organize, administer, and monitor. However, efficiency is so low in the emerging market economies that a great many opportunities exist for investments with returns far greater than are available for most supply projects. Improving the use of energy will greatly ease requirements for new supply facilities, which should benefit both economies and environments.

As discussed in the previous chapter, the World Bank's record in supporting end use projects is quite weak, though there are some signs of improvement. Giving equal weight to energy-efficiency improvement would almost certainly improve the economical balance of the Bank's projects, but it would also demand changes in the Bank's policies and practices. Some shift in emphasis may be instigated if Congress makes it clear that funding should be based insofar as possible on a least-cost analysis. Full equality might require a major renegotiation of principles.

CONCLUSIONS

Ideally, one would like to be able to identify the probable results of any given U.S. policy in Eastern Europe. That is not possible because of the great uncertainties and complexities of the situation. We don 't know which countries are going to succeed with economic reform and democratization, or the paths that the others will take. Nor can we quantify the impact that U.S. energy-efficiency initiatives would have, largely because the economic situation is so confused.

Some countries appear likely to succeed economically: Hungary, Poland, and the Czech republic. The Slovak republic and the Baltics also have a good chance after current difficulties are overcome. All of these countries will encounter many major problems and setbacks, but the questions seem more related to how fast, rather than if, they will recover.

Russia, Ukraine, and other republics of the FSU are less predictable. Replacing 70 years of entrenched central planning and one-party rule will be excruciatingly difficult. Current leaders seem committed to economic reform of some sort, but it is not at all clear how political struggles will evolve and whether future leaders will be as cooperative.

The Case for Major Assistance

If U.S. policy makers see such constructive cooperation as being in the U.S. interest, then major increases in foreign assistance should be considered, particularly for Russia and other FSU republics. Most of the economic infrastructure needs to be rebuilt over the next several decades, which is likely to cost hundreds of billions of dollars, most of which will have to be generated internally. U.S. assistance over the next few years can help stabilize economies and point them in the right direction. Even though the impact of U.S. assistance cannot be accurately quantified, it certainly can be substantial if targeted appropri-

[6] U.S. Congress, Office of Technology Assessment, *Fueling Development: Energy Technologies for Developing Countries, OTA-F? 516 (Washington DC:* U.S. Government Printing Office, April 1992) p.278.

ately. Major increases in aid, perhaps to several billion dollars per year, will greatly increase the chances for Russia and the other countries in the region to avert economic chaos and political authoritarianism, and move onto a path of economic recovery. It would also help control potential proliferation of both nuclear weapons and conventional arms. If these countries are to be our friends, now is when they need help.

The energy efficiency assistance considered in this report will directly improve the economic situation and encourage economic reform. The leverage on both goals should be quite high because energy is used so wastefully. In addition, the United States will gain some benefits because the conserved petroleum will be available for the world oil market. Energy-efficiency improvements are likely to be beneficial no matter what happens politically and economically, and the gains should greatly outweigh the costs.

The Case Against Increased Assistance

Few people are against economic progress in Eastern Europe, and probably none are against democratization. However, there are other priorities also. This country has its own great needs, including reducing the budget deficit. It is difficult to ask the U.S. taxpayer to support former adversaries when the same funds could produce direct benefits here. Furthermore, foreign assistance may be largely wasted if it does not ''work' in promoting economic reform and democratization. If it does work, these countries could turn into future competitors or even adversaries, and we would have contributed to their strength.

Neither of these perspectives can be explicitly refuted. Economic assistance in general, and energy efficiency in particular, will almost certainly be beneficial for people who badly need help, and will serve U.S. national interests. However, it cannot be shown that increases in assistance definitely will avert economic disaster or political instability. Generous assistance just makes these possibilities less likely. Whether that improvement is worthwhile is a matter of judgment of national priorities.