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).

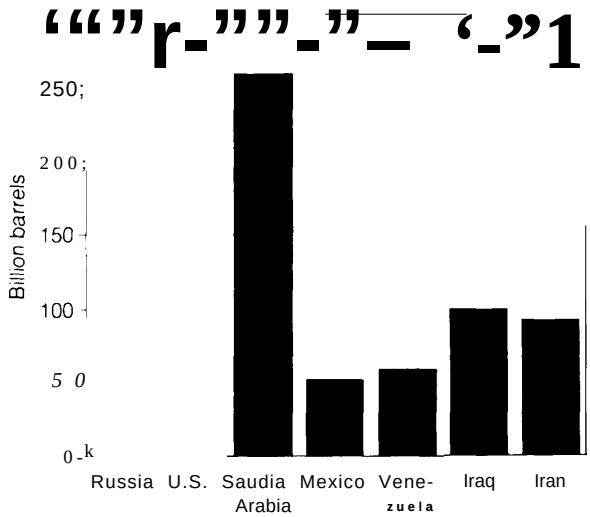
Oil

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.

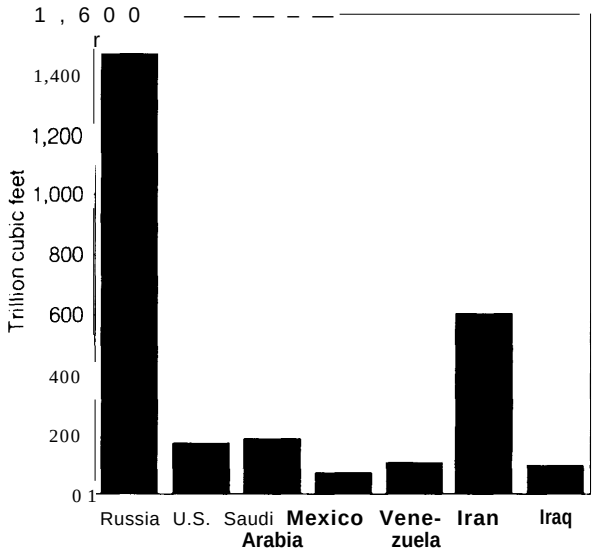
21 Ibid.

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.

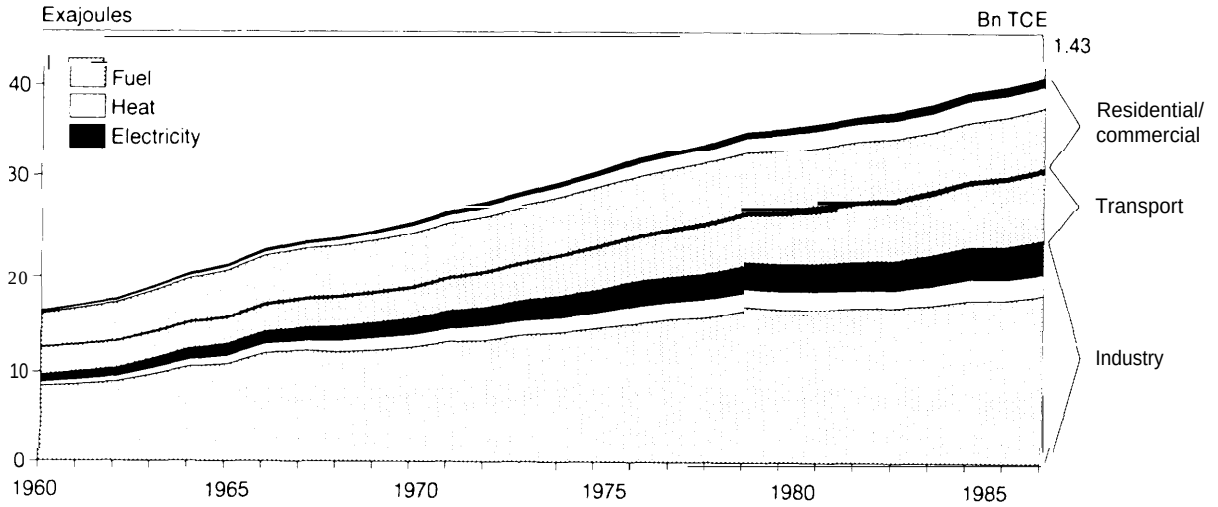
District heating[46] is used primarily in urban areas. Its feasibility is dependent on the size and location of the city. In rural areas, fuel usually is used directly. Natural gas, kerosene, wood, and coal are the most frequently used fuels. According to Lawrence Berkeley Laboratory (LBL), in 1985 about 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.

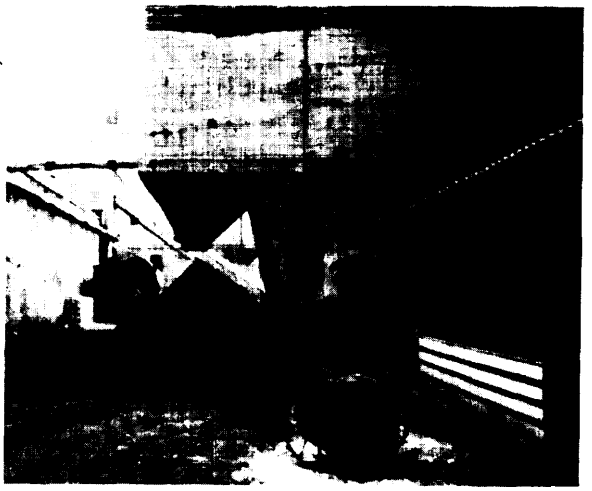
Figure 3-3—Energy Use in the U.S.S.R. Sectoral Breakdown of Energy Forms



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

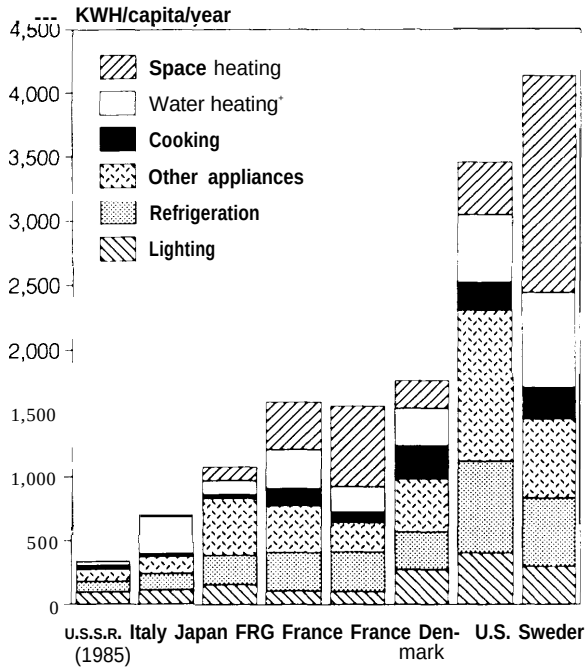
48 Ibid, pp. 19-21.

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

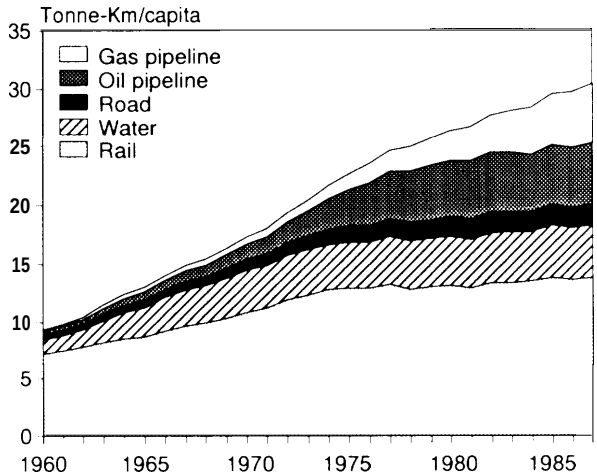
The energy intensity of passenger air travel is comparable to that in the United States. The primary reason is that Soviet-designed aircraft are packed with passengers. According to LBL, they have an average load factor of 97 percent.[60] However, the aircraft are inefficient if measured in energy use 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.

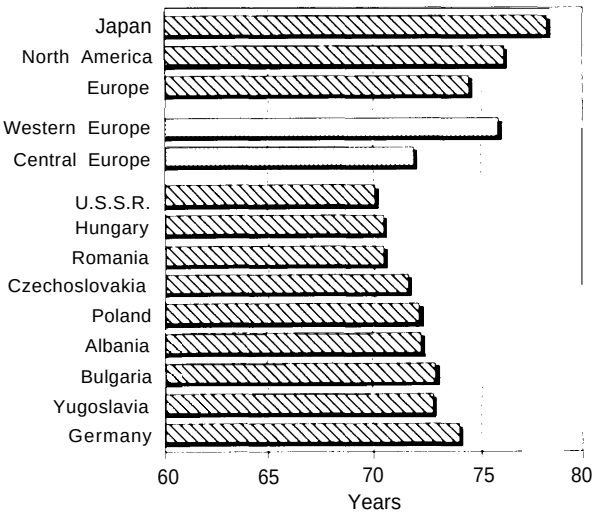
about 30 percent of foods have high concentrations of pesticides.[74]

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.