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Industrial Pollution in the USSR: Growing Concerns But Limited Resources

An Intelligence Assessment

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Industrial Pollution in the USSR: Growing Concerns But Limited Resources

An Intelligence Assessment

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Industrial Pollution in the USSR: Growing Concerns But Limited Resources

Key Judgments

Information available
as of 15 September 1989
was used in this report.

The severe and worsening pollution of the USSR's air and water has emerged as an important political issue for Moscow, but, at a time of staggering budget deficits and heightened competition for resources, the Soviets cannot afford effective pollution control. Although Moscow is likely to step up its efforts to clean up the environment— at some cost to industrial modernization and other key programs—the measures taken are unlikely to amount to more than attempts to get by “on the cheap.” As a result, pollution from industrial sources almost certainly will increase and cause continuing political and economic difficulties for the already problem-plagued regime.

Pollution has become a political issue because of the alarming levels it has reached and because the leadership has encouraged public debate on the subject. As the Soviets acknowledge, no large industrial city in the USSR meets World Health Organization standards for maximum permissible concentration of pollutants in the atmosphere, and half of all municipal water supplies have pollution levels 10 times Soviet national standards. In addition to publicizing such abuses, Gorbachev has raised the priority accorded environmental protection by adopting resolutions to protect Lake Baikal, the North Caspian Basin, and the Aral Sea; by subjecting officials to increased disciplinary action for failure to comply with antipollution directives; and by creating, in January 1988, a new State Committee for the Protection of Nature (Goskompriroda). His policy of *glasnost* has resulted in civic actions and investigative reporting that have helped close, convert, or halt the construction of numerous industrial plants. A draft environmental program now in preparation promises ambitious goals for reducing air and water pollution.

Fixing the problem, however, is extremely costly. Soviet officials estimate that meeting draft program targets will require a total expenditure of more than 400 billion rubles—an amount nearly equivalent to total annual budget outlays—over the next 15 years, including capital investment of 135 billion rubles—an average of three times the annual level of investment currently devoted to environmental protection. Moreover, the success of the program is dependent on substantial progress in economic reforms that attempt to make industrial enterprises more autonomous and responsive to economic rather than to administrative levers. In particular, the Soviets need to make it unprofitable to pollute the environment or waste natural resources by setting more rational prices for energy and raw

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materials. They must also enforce environmental protection legislation more effectively and impose fines large enough to deter polluters.

The costs of fixing the pollution problem doubtless appear especially burdensome to Soviet Government officials struggling to reduce a budget deficit amounting to 13 percent of their GNP and to industrial planners and enterprise managers already strapped for funds to modernize obsolete plants and equipment. Much of the needed pollution control technology, moreover, is not available domestically, and hard currency shortages limit the amounts that can be imported. In addition, Soviet central officials and enterprise managers are concerned about other potential costs of pollution control—the production declines that would result from closing down polluting plants and the popular backlash that would result from raising prices to provide the funds for environmental protection.

The Soviets will probably concentrate their pollution-fighting efforts on only the most critical cases, reequipping the worst polluters or relocating them away from heavily populated areas. Under such an approach the economic losses resulting from pollution probably will continue to grow. So too will the resentment of Soviet citizens who, in growing numbers, are outraged by the pollution problem. These developments will increase the chances of social unrest and worsen Gorbachev's political problems. Failure to clean up the environment at home will also aggravate existing transnational and global environmental problems such as acid rain, the greenhouse effect, and depletion of the ozone layer and will damage Soviet relations with other countries.

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Contents

	<i>Page</i>
Key Judgments	iii
Scope Note	vii
A Growing Problem	1
The Major Culprits	1
Impact on the Economy	2
Health Effects	3
Reasons for Pollution	4
Pressure To Meet Output Goals	4
Unenforced Legislation	5
Lack of Investment	6
Inadequate Equipment and Technology	7
Fixing the Problem	7
The Goals	7
The Tools	9
Public Pressure	9
Regulation	10
The Obstacles	14
Competition for Investment	14
Shortage of Technology and Equipment	15
Lack of New Incentives	16
Outlook and Implications	18

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Scope Note

This paper discusses pollution from industrial sources in the USSR, the steps that Gorbachev is taking to alleviate the problem, their potential impact on his broader economic and political programs, and their prospects for success. It does not address radioactive releases, nuclear accidents, the drying up of inland waterways, or environmental problems of a global nature such as the greenhouse effect, all of which involve technical issues that require separate discussion. For similar reasons, the paper does not deal with environmental pollution caused by excessive and improper use of fertilizers and pesticides in agriculture. This paper expands and updates a previous DI Intelligence Assessment **C**

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Industrial Pollution in the USSR: Growing Concerns But Limited Resources (U)

A Growing Problem

The Soviet Union is in a state of ecological crisis.

Fedor Morgun, former Chairman of the State Committee for the Protection of Nature, CPSU Party Conference July 1988

Growing pollution in the USSR has resulted in severe deterioration of the quality of air and water and has reached levels that are alarming by both Soviet and international standards. Soviet industry is responsible for the lion's share of this problem. According to Soviet sources, for example:

- Air pollution in all industrial centers exceeds Soviet health norms and in 102 cities is often 10 times established standards.
- One-half of all municipal water supplies have pollution levels 10 times Soviet national standards.
- Soviet industry emits nearly three times as many pollutants into the atmosphere as does US industry.
- The European region of the USSR alone produces nearly one-third more sulfur dioxide emissions than all of the European Community.
- The USSR accounts for about one-fifth of the carbon dioxide released from fossil-fuel combustion worldwide

The Major Culprits

According to Soviet journals, almost every branch of industry bears part of the guilt for the pollution problem (see table 1). The main sources of air and water pollution are:

- The *electric power* industry, which is responsible for one-fourth of all harmful substances released into the atmosphere of the USSR, according to the

The Soviets assess dangers to human beings from levels of atmospheric pollution as follows: concentrations of materials up to five times maximum permissible concentrations (MPCs), warning zone; 10-15 MPCs, immediate threat to health; 25 MPCs and above, extreme hazard to health

Table 1 Atmospheric Discharges of Harmful Substances From Stationary Sources by Soviet Industry, 1987 *Million tons*

Total	64.1
Of which:	
Ministry of Power and Electrification	16.5
Ministry of Ferrous Metallurgy	10.9
Ministry of Nonferrous Metallurgy	6.2
Ministry of the Construction Materials Industry	3.9
Ministry of the Timber Industry	1.7
Ministry of the Coal Industry	1.5

Source: *Vestnik statistiki*, No. 6, 1988.

Soviets. Coal- and oil-fired power plants account for 70 percent of the sulfur dioxide and 40 percent of the nitrogen compounds released.

- *Ferrous metallurgy* enterprises, which discharge about 1 cubic kilometer of effluent into surface water and over 10 million tons of dust and pollutants into the air annually, accounting for 17 percent of atmospheric pollution by industry.
- *Nonferrous metallurgy* enterprises, which are major sources of sulfur dioxide, nitrogen oxides, and particulates. The 18 cities in the USSR where nonferrous metallurgy enterprises account for the bulk of discharges of pollutants from stationary sources are among the cities with the highest levels of air pollution (see figure 1).
- *Chemical and petrochemical* plants, which discharge harmful substances into the atmosphere and surface water bodies. Enterprises of the former

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Figure 1. "What do they breathe in the city?" Pollution from smeltine furnaces in the Ural city of Karabash smelts. 21 April 1988.

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Ministry of Mineral Fertilizer Production alone annually discharge over 700,000 tons of harmful substances into the atmosphere and release more than 630 million cubic meters of polluted effluent into surface water bodies.

- *Pulp and paper* mills, which emit pollution consisting of gaseous emissions containing high concentrations of sulfur compounds, chlorine, other chemicals, and toxic sludge. Economist Abel Aganbegyan described this industry as "occupying first place amongst the sources of water pollution."
- The *construction materials* industry, where the most serious sources of pollution are cement plants that coat the countryside with dust. Because of wornout production and dust-collection equipment, for example, the Tbilisi Asphalt Concrete Plant has dust emissions that are 23 times the maximum permissible level.

Most of the major cities that suffer from excessive atmospheric pollution are in the heavily industrialized European USSR, but Siberian cities that have major industrial facilities have not escaped, and towns such as Bratsk and Angarsk are especially polluted. Fedor Morgun, the former chairman of the State Committee for the Protection of Nature, remarked that the

Donbass area of the Ukraine, which contains a large concentration of heavy industry and coal-burning power plants, is more polluted than the Ruhr Valley was at its worst. Citizens of Yerevan, Armenia, complain that the air is so bad they can no longer see Mount Ararat, a snow-capped, 5,165-meter mountain, 60 kilometers (km) away.

Impact on the Economy

According to Soviet estimates, total environmental damage caused by industry costs the economy 50 billion rubles each year, about 5 percent of the annual gross value of industrial output. The costs involved are of various types. According to Morgun, for example, water pollution and other consequences of industrial activities have resulted in a drastic decline of the fish catch in internal water reservoirs in the last 10 years. Pollution has damaged spawning areas in the Volga-Caspian Basin, which account for 85 percent of the world's sturgeon fishing, the source of valuable caviar. Industrial pollution in the Caspian Sea alone causes annual losses of fish production valued at about 500 million rubles. Largely because of water pollution, the total fish harvest today is only one-fifth that of 50 years ago, according to a Soviet report.

Solid-waste pollution from industrial plants and mining combines also often takes up land that could be used for agriculture. Up to two-thirds of all ores are extracted by open pit mining, which is 10 times more damaging to the land than underground mining. In the Kursk Magnetic Anomaly, for example, 25,500 hectares (63,000 acres) of fertile land have been lost to agriculture, and the Soviets expect that another 5,000 hectares will be destroyed every five years. At the Soligorsk potassium fertilizer mine, 400 million tons of tailings occupy 1,500 hectares of good farmland.

Costly damage to the environment has also come from acid rain—the result of emissions of sulfur and nitrogen oxides—which has damaged forests and agriculture. On the Kola Peninsula, for example, forests within a 20-km radius of the Sevronefel' Combine—a large nickel-processing enterprise—are completely dead, and trees as far away as 60 km are in poor condition. The Soviet press has reported that a sizable amount of cotton plantings were killed in Uzbekistan in 1988 because of acid rain caused by emissions from the Almalyk mining and metallurgy facility. At the same time, fluorine pollution from aluminum plants in the Uzbek and Tajik Republics reduced fruit and silk cocoon harvests and adversely affected cattle. According to a Soviet report, bogs in northeast Estonia, the main water resource for the area, will disappear in the next 30 years if something is not done about fly ash pollution from oil-shale-burning power stations.

In addition to such indirect costs, air pollution has become so severe in some areas that the Soviets have been forced to move residential areas and even whole villages at considerable expense. For example, air pollution from pulp mills and an aluminum plant forced the city of Bratsk to resettle two entire residential areas at a cost of 100 million rubles. More than 350 families residing in Pavlovka are scheduled to be resettled because of incidents of large-scale sulfur dioxide poisoning caused by emissions from the Orenburg gas works in 1988.

Health Effects

Beyond the physical damage to the environment, industrial pollution also has a costly adverse impact on the health of the population. According to Soviet

Table 2
Major Atmospheric Pollutants

Type of Pollutant	Major Sources	Impact on Health
Sulfur dioxide	Power plants burning coal and high-sulfur fuel oil, ferrous and nonferrous metallurgical plants, petrochemical plants, and oil refineries.	Aggravates heart disease and preexisting respiratory conditions such as asthma and chronic bronchitis, and increases morbidity and mortality.
Nitrogen oxides	Power plants burning fossil fuels and automotive emissions.	Causes bronchitis and pneumonia. Contributes to formation of ozone, which has been associated with respiratory irritation and heart disease.
Carbon monoxide	Ferrous metallurgy enterprises and automotive emissions.	Causes increased incidence of lung and respiratory disease.
Particulates	Power plants burning coal and oil shale and ferrous and nonferrous metallurgy and cement plants.	Causes upper respiratory disease and skin and corneal inflammation.

data, for example, one-fifth of all expenditures associated with the treatment of illness is caused solely by atmospheric pollution (see table 2). Although the Soviets report that industrial emissions of all pollutants were 9 percent less in 1987 than in 1980, they acknowledge that no large industrial city in the USSR meets World Health Organization standards for maximum permissible concentrations of pollutants in the atmosphere.

In key industrial centers in the Urals, Soviet doctors have traced the high incidence of lung cancer and respiratory disease to air pollution from local factories. Emissions from synthetic protein plants of the

Ministry of the Medical Industry also have been responsible for atmospheric pollution that has caused illness (see inset). In Magnitogorsk, a leading metallurgical center, the rates of lung and respiratory diseases are far above national averages, especially among children. Life expectancy in this city is reportedly 52 years, far below the national average of 69. In Smolensk, a light bulb factory polluted the Dnepr River with mercury levels 140 times greater than permitted—an abuse that was discovered only when local schoolchildren began suffering from loss of eyesight, trembling, and other symptoms of mercury poisoning.

Reasons for Pollution

Ecological problems do not arise spontaneously. They are the consequence of our technological and ecological incompetence, mismanagement, and irresponsibility.

*Fedor Morgun,
CPSU Party Conference
July 1988*

Moscow largely ignored the effects of economic development on the environment until recently. The emphasis on rapid industrialization and the overriding pressures to meet industrial output goals have dictated a low priority for environmental matters. Even as its attention to the problems has increased, Moscow has not devoted the resources necessary to deal effectively with pollution nor given managers appropriate incentives to tackle it. Moreover, few incentives exist in the USSR for the careful use of natural resources or protection of the environment. Instead, the idea that natural resources are inexhaustible has fostered excessive waste and resulted in large-scale pollution.

Pressure To Meet Output Goals

In the Soviet economic system, where the main indicator of success is meeting output goals, there are built-in incentives to pollute. Funds spent on pollution control equipment are considered "nonproductive" expenditures that seldom generate increased production or profits and reduce the amount of money

Pollution Impact on Public Health: The Case of the Kirishi Biochemical Plant

Within months of the opening of a synthetic protein plant at Kirishi, near Leningrad, the local bronchial asthma rate increased 20 times, and the incidence of skin disease also rose. Protein dust, which caused these problems, was defined under existing health rules as practically harmless. People continued to become ill from the emissions, however, and, in 1985, 10 years after the plant began operating, scientists declared the protein dust a hazardous substance. The Ministry of Health found disablement due to respiratory disease in Kirishi to be twice that of the RSFSR average and the incidence of bronchial asthma and asthmatic bronchitis to be five to 10 times higher than in other nearby cities. The dust also caused a marked lowering of natural immunity against disease.

Local health authorities halted the enterprise's operation at least 12 times, but each time strong pressure from the Ministry of the Medical and Microbiological Industry enabled the plant to resume production. In 1987, 12,000 people demonstrated in the city's square to force closure of the plant. Ten thousand citizens signed petitions that were sent to the Central Committee in Moscow. The Ministry finally endorsed a decision to close the plant temporarily for reconstruction and modification of its output mix in June 1987. Two months later, although the reconstruction was incomplete, the plant started operating at one-third capacity, and the emissions continued. Threatened with a city government decision to halt production on 1 August 1989, Gorbachev and a deputy chairman of the USSR Council of Ministers ordered the Ministry to submit by 1 October options for converting the plant.

available for equipment to increase output. Moreover, orders that enterprises receive from ministries often oblige them to violate environmental requirements.

A worker at the Nizhniy Tagil Metallurgical Combine recounted a story in 1988 that clearly illustrates the damage to the environment resulting from the prevailing attitude of "the production plan at any cost":

I stand at the control panel, and when tongues of flame shoot out of the oven, I see it is beginning to choke. In order not to hamper the smelting, there is one thing to do--open the pumps and vent the smoke. Yes, release the smoke into the atmosphere over the city.

The Ministry of Health decreed that two old polluting coke-oven batteries at this enterprise could continue operating only until a new one started up. The Ministry of Ferrous Metallurgy, however, ignored the agreement even when the new battery went on line because it had state orders for output that could not be met if the old coke-oven batteries were shut down.

Because of the emphasis on production, construction of pollution control facilities has always proceeded at a slower pace than those for production, and plants are frequently commissioned before environmental protection facilities are in place. Moreover, industrial plants at times provide false data on pollution levels in order to maintain production. Checks made in 1987 at several polluting factories by a Supreme Soviet commission revealed that, under pressure from management, ecological laboratories had knowingly falsified data on pollution.

Unenforced Legislation

Neglect of antipollution laws has been another natural consequence of the Soviet emphasis on production at any cost. The USSR has the strictest standards in the world for discharges of many pollutants, and laws on the protection of nature have been in effect since the 1917 revolution. Unfortunately, the emphasis on production and the unattainable goals embodied in these laws have engendered a certain contempt for environmental legislation. The basis of the problem is that the state is both the owner and regulator of production facilities and that strict enforcement of existing regulations would hinder industrial production.

The criminal codes of all the republics of the USSR contain articles stipulating punishments for causing environmental damage, and some republics have proved more willing to enforce these decrees than have the all-union authorities. Local efforts have been generally ineffective, however, because the largest industrial enterprises, which are usually the major polluters, generally are accountable only to the central government. For example, local authorities in Estonia cannot require oil shale mines or power plants, which are subordinate to Moscow, to treat emissions into the atmosphere and effluent into water bodies as required by Estonian law. Similarly, in 1988, the RSFSR Ministry of Land Reclamation and Water Resources (Minvodkhoz) found that the Zavolzhsk Chemical Plant was annually dumping 9 million cubic meters of untreated waste containing as much as 1,000 times allowable levels of toxic substances. Minvodkhoz decided to close the enterprise, but the central ministry overturned the decision, and the plant is still operating. In another case, a memorandum from an environmental official in Baku to a higher authority complaining about serious pollution by a local oil refinery in 1988 was returned immediately with an irate note telling the official to mind his own business.

Soviet industries also have circumvented pollution standards in other ways. When limits for pollutants are deemed too stringent, they frequently are re-adjusted to correspond to the available treatment system, or the plants are granted an "exception" to exceed maximum permissible levels. These exceptions generally are given to enterprises with plans to install pollution abatement facilities or to change their production processes to less polluting technologies at some point in the future. The future, however, sometimes never comes. Even fines for polluting the environment are largely ineffective because of their limited size and because a large share is never collected. Because ministries intend to pollute, they often set aside funds in their budgets to pay the fines. Furthermore, polluters are not required to pay to restore the environment to its previous state.

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Recognizing the near hopelessness of their pollution-fighting task, prosecutors and environmental control authorities frequently have failed to make use of the rights granted them to bring cases to trial, shut down polluting facilities, or demand that the ministries or departments remove guilty officials or institute disciplinary proceedings. According to a Soviet specialist on environmental law, many violations never fully come to light or are never formally registered. Investigations are carelessly carried out, and all measures are adopted to minimize the penalty, if not to wipe it out entirely. In 1987 the number of criminal court cases resulting from violation of environmental regulations declined by one-third (two-thirds in the Ukraine) compared with 1986. No cases were sent to court in the Uzbek, Lithuanian, Azerbaijan, Moldavian, Tajik, or Turkmen Republics.

Lack of Investment

Incentives and legislation aside, the reduction of pollution requires resources, and, here especially, Soviet pollution control efforts have come up short. For all the lipservice paid to the pollution problem in recent years, the share of total investment devoted to environmental protection was larger in 1975 than it is today (see table 3). Total outlays for environmental protection in the USSR amounted to only about 1.1 billion rubles in 1988, including 3.1 billion rubles for capital investment and funds for operating costs and the forestry sector. The Soviets, who have a more serious pollution problem than the United States, devote about 0.7 percent of their gross national product to environmental protection compared with 1.7 percent in the United States.

Soviet data on pollution control spending, moreover, probably overstate actual expenditures because many enterprises do not use the funds provided or spend them for other purposes. According to a Soviet environmental official, for example, only 85 percent of capital investment allocations for environmental protection was used during the period 1976-85. The Ministry of Ferrous Metallurgy, in particular, has historically not spent the funds allocated to it for

Table 3
USSR: Capital Investment for
Environmental Protection

	Total Expenditures (million 1984 rubles)	Share of Total Investment (percent)
1975	2,430	1.8
1980	2,215	1.4
1981	2,151	1.4
1982	2,162	1.3
1983	2,057	1.2
1984	2,285	1.3
1985	2,486	1.4
1986	2,615	1.4
1987	2,663	1.3
1988	3,119	1.4*

* Estimated.

environmental protection measures, and environmental expenditures in 1981-85 were even less than in the previous five-year period. Similarly, none of the ministries in the fuel-energy, chemical-timber, or metallurgical complexes fulfilled the plan for putting environmental protection facilities into operation in 1988.

The inability of construction organizations to handle installation of pollution control facilities is the major reason allocated funds are not spent. A former construction minister reported in 1986 that the share of environmental protection facilities in his organization's planned total volume of construction and installation work was only 3 to 4 percent and that these plans were usually underfulfilled. Delays in the construction of a waste-water treatment complex at the Stebnik Potassium Combine resulted in the bursting of a dam holding industrial wastes in 1983, causing losses to farms in the Ukraine and Moldavia that totaled millions of rubles.

Inadequate Equipment and Technology

In a production-oriented economy, moreover, there is little incentive to develop pollution control technology or to move it quickly through the research and development-to-production cycle. Consequently, the technological level of pollution abatement equipment produced in the USSR lags years behind that of the West. At the same time, production of this equipment is inefficient. Each industrial ministry tends to develop its own equipment, resulting in needless duplication. Organizations tasked to design and produce pollution control equipment have other, higher priority responsibilities, and production of such equipment tends to get short shrift. For example, the Ministry of Heavy Machine Building, which is responsible for producing much of the equipment for the oil, gas, and chemical industries, is the head ministry for developing and producing most effluent-gas cleaning equipment. Because of higher priority for production of other machinery, however, it has not devoted the resources to developing equipment for removing sulfur and nitrogen oxides from stack gases. Most cleaning of industrial waste gases has generally consisted merely of trapping particulates.

Shortages, poor design, and inferior quality of equipment mean that many large industrial plants are either not outfitted with pollution control equipment, or that when such equipment is installed, it does not operate effectively and frequently breaks down. Maintenance of pollution control equipment is poor because of the lack of trained specialists. Almost one-third of existing waste-water treatment facilities do not provide purification that meets standards, and more than one-third of pulp and paper mills have no such treatment facilities at all. Less than one-third of the sulfur dioxide, fluorine compounds, nitrogen, and other harmful substances from industrial facilities is removed before waste gases are released into the air, according to the Soviets. Currently operating central power and heating plants do not have equipment for removing sulfur and nitrogen oxides from waste gases, and existing ash-trapping systems are ineffective.

Fixing the Problem

In establishing a healthy way of life, particular attention must be paid to environmental protection. . . . The state of affairs here is worrying, to say the least.

*Mikhail Gorbachev,
Address to the Congress
of People's Deputies
May 1989*

Since Gorbachev came to power, the Soviet leadership has become increasingly concerned with the pollution problem and has raised the priority accorded environmental protection (see figure 2). Gorbachev's promotion of *glasnost* has enabled pollution to become a highly visible issue. His emphasis on achieving growth by improving efficiency rather than by using more resources is intended to help alleviate some of the chronic environmental damage associated with past shortsighted approaches to natural resource development and use. Gorbachev, in fact, is the first Soviet leader to include environmental deterioration in his list of national priorities as voiced in governmental forums.

Among the general public, as well as within the leadership, environmental problems are now being viewed as critical issues. Tatyana Zaslavskaya, a leading Soviet sociologist, claimed in March 1988 that public opinion polling data indicated that the ecological crisis ranked ahead of other public concerns such as availability of food and other consumer goods, housing, or higher prices. Nearly all the candidates for election to the Congress of People's Deputies in March 1989 had an ecological plank in their platforms.

The Goals

For all of the attention being devoted to environmental protection, the Soviets have been slow to come out with specific goals. The 1986-90 Five-Year Plan

Figure 2.



contained only a general section on the protection of the environment and rational utilization of natural resources, which called for wider introduction of low-waste and waste-free technologies, better use of natural resources, protection of the country's water resources and atmosphere, and improvement in monitoring sources of pollution. The 1989 annual plan contained similar language as well as plans to require new and reconstructed facilities to have effective pollution control. At the same time, three of 14 high-priority science and technology programs announced in January 1989 concern environmentally clean chemical and steel production, energy generation, and transport. In one of the few specifics disclosed so far, Morgun said at the signing of an environmental cooperation agreement with Sweden in April 1989 that the USSR will reduce emissions into air and water by 30 to 50 percent in the next four to five years. On the Kola Peninsula, emissions are to be cut by 80 percent.

In spite of Gorbachev's apparent concern with reducing pollution, however, his other plans appear to conflict with pollution control targets. For example, a

1988 report of the State Planning Committee revealed that it is loosening restrictions on waste-water emissions for the pulp and paper and natural gas industries in the interest of increasing production. Similarly, although Gorbachev has sought to improve the efficiency of the economy, in the last three years there has been little improvement in either conservation or the efficiency of resource use. The 1989 plan called for growth in energy production above levels set forth in the original five-year plan.

Much more ambitious environmental protection goals, however, appear to be forthcoming. According to one of the compilers of a promised draft program for the protection of the environment and rational utilization of natural resources through the year 2005, the USSR plans to:

- Stop all discharges of effluent into natural water reservoirs by the year 2000 and raise the quality of the country's main reservoirs to national standards by 2005.

- Halve atmospheric emissions from stationary sources.
- Reduce by 80 percent emissions of specific pollutants from enterprises located in 276 cities with high levels of air pollution.
- Triple commissionings of gas-scrubbing installations.
- Reduce air pollution from motor transport by 48 percent.
- Increase the annual volume of reforestation to 2.5 million hectares, exceeding the total area of timber felled each year.

The program will also provide for payment for the use of natural resources, and, in 1991, plants will be assessed a set of progressive fines linked to the level of damage they have caused the environment. Whether these goals will be realized or even maintained, of course, remains to be seen.

The Tools

To achieve the new and projected pollution control targets, Gorbachev is using the same set of tools employed in his overall *perestroika* program. These include the mobilization of public support for pollution control, the enforcement of greater discipline against polluters, and administrative reorganization. The regime has also talked about increasing the resources allocated to pollution control and enacting needed reforms, but there has been little follow-through to date.

Public Pressure. Gorbachev's campaign to democratize and reform the system has given the populace an unprecedented opportunity to speak out on the pollution problem. The most visible manifestation of the new attitude toward environmental issues is the candid presentation of ecological problems in the media. Gorbachev's liberalized policy for state-controlled media has allowed environmental activism to receive greater, more candid coverage than ever, and the press, radio, and television are joining the people in calling attention to problems and demanding solutions (see figure 3). The resultant public pressure, which has included demonstrations and protests, has actually influenced planning decisions and closed down some

industrial operations—a fundamental break with traditional Soviet policymaking procedures (see inset). Nevertheless, complete freedom of the press and full disclosure of environmental information are still a long way off.²

Petitions and demonstrations against specific cases of environmental damage generally have been allowed to proceed without hindrance probably because they are in line with current policy of encouraging grassroots activity to restrain the ministerial bureaucracies. In August 1988, an official of the USSR Procuracy explicitly said that environmental protests should be allowed. Soviet authorities may consider environmental demonstrations a safe vehicle for citizens to vent frustrations that otherwise might lead to political protests.

The environmental situation, nonetheless, has given rise to political groups that have organized demonstrations and antipollution drives. In Armenia, the Ukraine, and the Baltic republics, nationalism has played a role in ecological protests. The original demonstrations in Yerevan, Armenia, in February 1988, which decried air pollution from a nearby synthetic rubber factory, preceded and appear to have catalyzed ethnic unrest about the political status of Nagorno-Karabakh.³ Also, the Greens movement in Estonia—a stronghold of nationalism—has led to protests against expansion of phosphate mining in the region. In the Baltic republics, other protests against industrial projects may have been stimulated more by opposition to a further influx of ethnic Russians than by concern about damage to the environment.

² In the Ukrainian city of Chernobyl early this year, a group of children became ill with nervous disorders, hair loss, and nausea. After weeks of investigation and speculation, doctors attributed the illness to exposure to thallium from an unknown source. The local and national media gave inaccurate and contradictory information about the source of the problem and its dangers, and the actual cause of the problem has yet to be disclosed.

³ Armenians are demanding that Nagorno-Karabakh Autonomous Oblast—an Armenian enclave inside the republic of Azerbaijan—be reunited with the Armenian Republic.

Public Pressure on Industrial Facilities

Citizen protests have had an unprecedented influence in blocking industrial construction, closing or moving plants, or forcing plants to change to nonpolluting output. These actions by the Soviet authorities reflect a sensitivity to public comment that did not exist before glasnost. For example:

- *The Priozersk pulp plant was closed in 1987 for severely polluting Lake Ladoga. The plant is to be retrooled to make products whose manufacture is nonpolluting.*
- *The Shchekino nitrogen fertilizer plant discontinued production of fertilizers and resins in mid-1987 to protect Yasnaya Polyana, former residence of Tolstoy. The plant will shift to production of ion-exchange membranes, electrolyzers, and other non-polluting products. Closure of the fertilizer and resins lines cost the plant 60 million rubles, slightly more than 30 percent of annual output. Switching to nonpolluting output will require a more highly trained work force.*
- *The people of Ufa said "enough" to another chemical plant in December 1987, and, so far, have prevented the siting of a polycarbonate plant in their city.*
- *An old synthetic rubber plant in Yerevan, which had been polluting the city's atmosphere for many years, was finally closed in early 1988 after a demonstration that expanded into protests over the Nagorno-Karabakh issue.*
- *An environmental group influenced the central government's decision in 1988 to cancel construction of an apatite plant that threatened Lake Baikal with further pollution.*
- *After years of protests against the Baikal Pulp and Paper Combine for pollution of the waters of Lake Baikal and the surrounding atmosphere, a yeast plant at the combine was closed in 1988. The pulp facility also was ordered to convert its output to nonpolluting furniture products, but this will not occur until at least 1993, when another pulp plant at Ust'-Ilimsk is scheduled to begin operation. Plans to build a pipeline to carry wastes from the Baikal plant to the Irkut River as a temporary measure were thwarted by local residents who did not want their environment damaged.*
- *Plans to construct a large turnkey biotechnology project at Taroussa, near Moscow, were reportedly canceled in 1988 because residents exerted sufficient pressure on local authorities to relocate the proposed plant's functions.*
- *In August 1988, an antibiotics plant in Frunze was closed in response to public demand.*
- *City officials in Dneprodzerzhinsk stopped construction work on a coke chemical plant in September 1988 until a dust-free coal delivery system, a water recycling system, and a series of water purifiers were installed.*

Regulation. In an effort to strengthen existing environmental legislation, several new resolutions carrying legal weight have been adopted by the Central Committee and Council of Ministers. These include:

- An April 1987 resolution, "On Measures To Ensure the Protection and Rational Utilization of the Water Resources of Lake Baikal in 1987-1995."
- A July 1987 resolution, "On the Ecological Situation in a Number of the Country's Regions and Industrial Centers," which noted the acute ecological situation and the failure of ministries and departments to take the necessary measures to protect the environment. The resolution ordered the

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- Under pressure from the public, the former Ministry of Mineral Fertilizer Production canceled plans to build a phosphate fertilizer plant at Berezovka, near a recreation area in the southern Ukraine.
 - In May 1989, longshoremen at a new phosphate rock terminal in Odessa called a strike and refused to unload a ship because they claimed that adequate environmental safeguards had not been implemented.
 - In June 1989, the Astrakhan Oblast Environmental Protection Committee closed a gas-processing plant because excessive air pollution had damaged crops and the health of nearby residents.
 - Discussing the confirmation of Minister of the Medical Industry Valeriy Bykov at a recent session of the Supreme Soviet, Premier Nikolay Ryzhkov disclosed that a plan for doubling production of synthetic protein may be abandoned.
 - In late August 1989, public pressure forced a delay in the opening of a newly completed plant for the destruction of chemical weapons at Chapayevsk.

ministries to step up work on pollution abatement and stressed the personal responsibility of the leaders of ministries and departments.

- A January 1988 resolution, "Radical Restructuring of Environmental Protection in the Country,"

- A February 1988 resolution to ensure ecological safety during the development of oil and gas resources in the North Caspian Basin.
- A September 1988 resolution, "On Measures To Fundamentally Improve the Ecological and Sanitary Situation in the Aral Sea and Make More Effective Use and Improve the Conservation of Water and Land Resources in the Aral Sea"

Despite leniency and unenforced legislation in many cases, Soviet officials have also faced increased disciplinary action under Gorbachev for failing to comply with the new directives. A deputy minister of the timber industry, for example, was fired in 1987 for failure to develop a water recycling system at the Selenginsk Pulp and Cardboard Combine and for polluting the environment with industrial waste and gaseous emissions from the Baikal Pulp and Paper Combine. Later the same year, the former plant director and chief engineer of the Priozersk Pulp and Paper Combine were convicted in a criminal case for permitting the plant to seriously pollute Lake Ladoga.

The excessive fragmentation of environmental protection functions among various ministries and organizations and the absence of effective incentives to reduce pollution prompted the leadership in January 1988 to adopt a resolution creating, for the first time, a single body—the USSR State Committee for the Protection of Nature (Goskompriroda)—to oversee environmental protection issues and ensure rational use of natural resources.⁴ Goskompriroda was given a mandate to create and enforce a system wherein industries could no longer ignore the environmental impact of their activities (see inset).

⁴When Goskompriroda was established, the former State Committee for Hydrometeorology and Environmental Control was abolished. A new State Committee for Hydrometeorology is charged with earth remote sensing, weather forecasting, and environmental regulation, but it has no policy responsibility.

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Figure 3
Glasnost on Pollution

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Major Responsibilities and Rights of Goskompriroda

Goskompriroda has been tasked with:

- *Managing environmental protection in the country.*
- *Monitoring the use and protection of land, water, plants, and animals.*
- *Submitting proposals on environmental protection and rational use of natural resources for inclusion in the next five-year plan.*
- *Developing proposals for more efficient use of natural resources and setting standards for their use.*
- *Examining plans for siting industrial facilities, and monitoring observance of ecological standards in the development of new equipment, technology, and materials and designs for construction of enterprises.*
- *Issuing permits for storage of wastes.*
- *Managing nature reserves.*
- *Increasing participation of the scientific community in designing and building pollution control equipment.*

- *Delineating the environmental responsibilities of various state and party organs.*
- *Organizing the dissemination of information about the environment.*
- *Planning and implementing cooperation with foreign countries in environmental protection*

To implement these responsibilities, Goskompriroda and republic state committees for environmental protection have been given the right to:

- *Impose bans on construction of facilities and exploitation of natural resources that violate environmental legislation.*
- *Halt work by enterprises that violate environmental standards and rules.*
- *Bring suit against enterprises, organizations, and citizens for the reimbursement of losses resulting from pollution of the environment or "irrational" use of natural resources*

According to the resolution, decisions by Goskompriroda are binding on ministries and other organizations. Enterprises and organizations will be charged a standard fee for use of natural resources and emission of pollutants. A higher charge for exceeding allowable discharges, which will come from collectives' profits, will go into a reserve fund for unforeseen tasks associated with environmental protection. Goskompriroda and other appropriate agencies were instructed to draw up a new draft law on the protection of the environment and submit it to the Council of Ministers in 1989.

The significance of Goskompriroda is that it can influence the content of future environmental legislation by providing information on the extent of pollu-

tion problems and supplying the expertise needed for their solution. It probably also was designed as an enforcement agency, operating independently of the institutions committed primarily to fulfilling production targets. Goskompriroda's powers appear to be strong enough on paper, and the new law, when it is enacted, may strengthen them further.

Gorbachev's appointment in March 1988 of Fedor Morgun, a close ally, to head the committee was a sign that the leader had moved environmental issues up in the Soviet agenda. Morgun said that he realized he was battling powerful entrenched forces in the

country, and he voiced concerns that the management problems of setting up Goskompriroda may displace larger objectives in the early stages. Morgun resigned from his position in June 1989. Although he claimed in a recent press interview that his age, 65, was a major reason for his resignation, his comments clearly reflected his frustration with battling the ministries and departments and the lack of clout that Goskompriroda actually had in solving environmental problems. A replacement for him was not found until early August, when Professor Nikolay Vorontsov, a biologist, was appointed to head Goskompriroda. He is the first non-Communist party member in a central cabinet post.

Apparently, Goskompriroda already is having some impact. According to an economist at the USSR State Construction Committee (Gostroy), future construction plans and designs must now take environmental considerations into account, and Goskompriroda or its regional counterparts must approve virtually all construction projects in advance. The economist claimed that Gostroy also could not circumvent Goskompriroda's decisions to refuse permission to start work on a project. Moreover, in the chemical industry, no new production facilities are now allowed to start operation unless they have purification systems that guarantee environmental safety. During the first six months of its existence, Goskompriroda halted work temporarily or permanently on several industrial enterprises.

In addition, the leadership is taking steps to give the republics more control over the environment by including these rights in recently published draft principles on republic autonomy. All maximum permissible pollution standards are to be set by the republics, even for enterprises subordinate to Moscow, and the republics are to have the right to close facilities that cause dangerous levels of pollution or violate procedures for the use of natural resources. The republics also will be able to charge enterprises for the use of natural resources and for other expenses associated with environmental conservation.

The Obstacles

To ensure that the new measures to improve pollution are implemented, the Soviets need to back up their programs with the necessary resources and appropriate incentives. Unless there is long-range commitment to Goskompriroda's efforts, it will simply be outgunned by the country's industrial giants. In particular, the resource commitment must include funds for basic research, investment, education, and enforcement of regulations.

Competition for Investment. To achieve any success in improving environmental protection, the Soviets must increase budgetary outlays substantially. According to ~~6~~ antipollution measures in the draft plan for the environment through the year 2005 will require capital investment of 135 billion rubles over 15 years, an average of three times the level of annual investment currently devoted to environmental protection. Over the same period, total expenditures for environmental protection—including capital investment, operating costs, and funds for the forestry sector—will require more than 400 billion rubles, according to Petr Poletayev, a high Goskompriroda official.

These projected requirements may understate Moscow's needs. A Soviet expert has estimated that, at a minimum, Soviet industry needs to immediately invest 100 billion rubles, plus 6-7 billion rubles annually thereafter just to bring the problem of air pollution under control. The Soviets also have estimated that removing only sulfur dioxide from power plants burning coal and oil would require a one-time investment of about 18 billion rubles and operating costs of more than 1 billion rubles annually. To put these requirements into perspective, it should be noted that the entire current environmental protection budget is 11 billion rubles. In a classic instance of understatement, Morgun recently said that, "this is not enough, and more so since the funds are in the hands of the polluting departments."

Morgun has suggested that additional funds for environmental protection might come from cutbacks in military spending, and, in a speech in London in April 1989, Gorbachev seemed to concur, remarking that, "We shall not be able to save the environment unless we embark on a powerful disarmament and release resources to solve environmental problems." Even though Gorbachev's comment may have been directed primarily at the West, it could be significant that he sees using these potentially freed funds to help solve environmental problems.

But more than just money is required. Qualified personnel are needed to operate installations and pollution abatement equipment and to staff regional and local committees for environmental protection. In several areas, such as Lake Baikal and Irkutsk, local committees are being staffed by unqualified and uncommitted personnel, according to the Soviet press. Newly formed branches of Goskompriroda in large industrial centers in the Urals and Siberia have staffs of only one person. The Soviets also need to provide increased education for the public as well as training for personnel working in environmental protection. Even to attempt to deal with its current pollution problems, Moscow needs to compile a survey of the areas that are suffering the worst from environmental damage, outline specific measures to remedy the situation, and determine priorities for investment. Moreover, the cumbersome and ineffective monitoring system now handled by various state committees and ministries needs to be replaced with a unified system.

Shortage of Technology and Equipment. Even if given additional funds and manpower, Soviet pollution fighters are certain to be hampered by the USSR's chronic technological backwardness. According to Morgun, the most important problem in dealing with pollution is access to good technology. The Soviets need to develop more efficient low-waste and waste-free technologies, especially equipment to clean industrial effluents. Raising individual enterprise technology to world standards would drastically reduce environmental damage by industry; lower consumption of materials, energy, and labor; and upgrade

product quality. The technological levels of Soviet industry and pollution control equipment, however, lag far behind those of the West, and low-waste and waste-free technologies will not be available in the near future.

Another technology-related challenge for the Soviets involves the development of equipment for recycling pollutants—an important means of increasing the cost-effectiveness of protecting the environment. A Soviet study claims that the cost of producing sulfuric acid from exhaust gases at nonferrous metallurgy enterprises is lower than the cost of producing sulfuric acid from conventional raw materials at enterprises of the chemical industry. More efficient and comprehensive processing of minerals and metallic ores also could reduce the growing piles of tailings. A Soviet report claims that producing steel from scrap reduces air pollution by six times and water pollution by five times compared with conventional steelmaking.

The principal industries responsible for pollution need specific types of equipment and technologies:

- The *pulp and paper* industry needs to develop waste-free technology, install closed-loop water supply systems, and capture dust and gases prior to discharge. Implementation of these measures, however, would require development of new equipment and chemicals not now produced in the USSR.
- *Electric power* plants burning coal, oil, and oil shale need to install flue gas desulfurization equipment, but this equipment is virtually unavailable in the USSR. In addition to the high cost—as much as 40 percent of capital investment—this technology would increase energy consumption by as much as

* Although the Baikal Pulp and Paper Combine uses the most advanced Soviet equipment, it releases four times more chemicals per ton of paper produced than comparable plants in the United States.

* According to a Soviet scientist, average discharges of dust and sulfur dioxide from coal-burning power plants in the USSR are several hundred percent higher than those in the United States.

6 percent. Modern, efficient, multistage, electrostatic precipitators to remove fly ash from coal-fired power plants also are needed. Because the precipitators that the Soviets now have installed in power plants consume so much electricity, however, they frequently are turned off. According to a recent article in *Elektricheskiye stantsii*, the Soviets estimate that to meet proposed standards for atmospheric emissions, 216 exhaust-gas scrubbers to remove sulfur dioxide and nitrogen oxides would be required at a cost of tens of billions of rubles. No combustion technology presently available in the USSR or the West has completely resolved the problem of emissions of nitrogen oxides.

- In *ferrous metallurgy*, use of basic oxygen and electric steelmaking technologies would reduce formation of sulfur dioxide, nitrogen oxides, dust, and other pollutants. At the Nizhniy Tagil Metallurgical Combine, for example, the cost of reconstructing the converter shop to solve ecological problems is so high that a gas-treatment project is being dropped from the plan.
- In *nonferrous metallurgy*, reconstruction of lead and zinc enterprises to incorporate waste-free, oxygen-electrothermal technology for clean processing of ores would drastically reduce the pollution associated with traditional lead and zinc refining. Broadening the use of fluidized-bed autogenous smelters like the one at the Noril'sk Mining and Metallurgical Combine would not only reduce sulfur dioxide emissions, but allow recovery of sulfur.

Sufficient supplies of pollution control equipment will not be available from domestic sources any time soon. The Soviets could obtain pollution control equipment from the West, but hard currency constraints and a conservative attitude toward borrowing will limit imports to that machinery and technology with the highest priority (see inset).

Lack of New Incentives. One of the best incentives for environmental protection would be to make it unprofitable for industries to pollute the environment or

The Soviets developed the KIVT'sET process for clean processing of lead, zinc, and copper ores and have sold the license abroad, but apparently it is not yet used commercially in the USSR.

waste natural resources. With regard to this point, Soviet academician Vladimir Sokolov stated in a recent *Izvestiya* article that "until ecology is written into society's income and expenditure accounts, it will make a loss." Moscow has taken the first steps with its proposals in the resolution establishing Goskompriroda, but the feasibility of such a mechanism depends on the successful implementation of Gorbachev's economic reforms, particularly price reform and self-financing of enterprises. Realistic pricing of natural resources and energy offers the potential of improving the environmental situation substantially by promoting conservation and more efficient production. Under self-financing, however, a policy of rational use and saving of natural resources is possible only if it is viewed as economically advantageous to enterprises. To achieve this, Moscow would have to increase wholesale and retail prices, introduce full payment for natural resources, and abandon unrealistically low prices for energy.

If pollution control efforts are to succeed, moreover, the concept of production cost also needs to be broadened to include the cost of returning the environment to its previous state. Implementation of such a measure would provide a stronger stimulus for industrial enterprises to move to less polluting production processes. In addition, fines must be made more effective deterrents to polluting the air and water. Penalties for pollution need to be large enough to deter violators and must exceed expenditures for environmental protection activities, making it more profitable for enterprises to reduce pollution. The cost of fines should not be passed on to the consumers, but rather paid out of enterprise profits. Heavy fines, especially if levied by an environmental monitoring service, independent of local and departmental organizations, with the receipts put in a regional environmental protection fund, could have a significant effect on reducing pollution. The Soviets could encourage compliance with environmental regulations by using part of these funds as bonuses for meeting such requirements.

* According to Abel Aganbegyan, existing domestic prices for fuel and raw materials are only one-half those on the world market.

The Role of the West in Soviet Pollution Control

As part of the effort to control industrial pollution, the Soviets are interested in drawing on Western technology and expertise. Various sources indicate that Moscow's purchases of Western technology will concentrate on production technologies that are designed to minimize emissions and effluents. For example, the Ministry of the Chemical Industry is now requiring that all new chemical plants imported from the West meet pollution standards:

- In a recent agreement with [redacted] to build a large chemical complex at Nizhnevartovsk, the Soviets specified technologies that will fully utilize waste gases and solid wastes and will not discharge any contaminated water.
- [redacted] won a contract in 1988 to modernize three chemical plants largely because the production process it offered was less polluting than those of its competitors.
- A recent contract with [redacted] to supply processing facilities for the Tengiz oilfield included new technology to recover nearly all the sulfur removed in treatment in order to meet stricter environmental regulations.

The Soviets also hope to gain access to Western technology through cooperative and joint-venture agreements. In the aftermath of Chernobyl, which damaged its international image, Moscow has become more concerned with the international implications of environmental protection. The USSR has been more forthcoming in recent months in international forums dealing with the environment, and is making a special effort to clean up the Baltics and the Kola Peninsula to reduce cross-border pollution:

- A five-year environmental cooperation agreement with Sweden, signed in April 1989, provides for research exchange and joint work in atmospheric pollution control. The Soviets eventually will be able to purchase Swedish pollution control technology under the agreement.

- The USSR and Finland signed an agreement in September 1989 to reduce sulfur dioxide emissions—originating mainly from Soviet enterprises on the Kola Peninsula—to 50 percent of 1980 levels by 1994.
- At USSR-Norwegian environmental talks last year, the Soviets claimed that they will halve emissions of sulfur dioxide from the nickel plants at Nikel' and Zapolyarnyy—near the Norwegian border—by 1993.
- Five Nordic countries recently proposed creating a joint fund from which firms producing environmentally safe technology can borrow money to set up subsidiary companies in Eastern Bloc countries in order to introduce purification technology.
- Under a Soviet-West German five-year environmental cooperation agreement, signed in October 1988 during Chancellor Helmut Kohl's visit to the USSR, priority attention will be given to protection of the Baltic Sea and the Volga and Rhine Rivers, processing of domestic wastes, and protection of the ozone layer of the atmosphere.
- Under a Soviet-Japanese environmental cooperation agreement, Japan plans to transfer to the USSR more efficient oil and coal combustion technology, which would reduce discharges of carbon dioxide and nitrogen oxides.
- The USSR and the United States have a bilateral agreement under which a number of projects are ongoing.

Although few joint ventures have been signed so far, a joint venture with [redacted] to produce equipment to remove sulfur dioxide and nitrogen oxides from waste gases was recently negotiated. Also, a Soviet-Italian joint venture, Prima, is to reduce pollution of air and water in the Moscow area.

Outlook and Implications

Although the Soviets are committed to reducing industrial pollution, it is unlikely that they will have the resources necessary to deal with the scale of environmental damage that already has occurred and to prevent further damage. Laboring under a staggering budget deficit, Moscow is desperately looking for ways to slash government spending. Moreover, with increasing competition from other high-priority needs, such as the long-term consumer and energy programs, it will be extremely difficult to get more funding for environmental protection. If funds are freed as a result of reduced military expenditures, other claimants probably will outrank ecology.

Much of the needed pollution control equipment and technology, moreover, is not yet available domestically; the hard currency to obtain it abroad is scarce, and the Soviets have not yet devised the correct incentives to encourage the future production and application of these new technologies. Soviet machine-building industries are already overwhelmed with orders for equipment to modernize Soviet industry and for machinery for the light and food-processing industries, and are unlikely to be able to assume a major role in the production of advanced pollution control equipment. Moscow probably will increase purchases of Western pollution control equipment somewhat, especially to deal with critical problem areas, and US firms could benefit because of their experience in pollution control technology. The Soviets also will encourage joint ventures and cooperative agreements to gain access to Western pollution control technology. Nonetheless, such efforts are likely to run afoul of the same problems that have impeded other joint ventures—the difficulty of repatriating profits earned in the USSR and the general dissatisfaction of Western firms with Soviet operating conditions.

Ultimately, the success of Soviet environmental policy will depend on progress in economic reform—whether enterprises can be made more autonomous and responsive to economic rather than administrative controls. The Soviets need to make it unprofitable for enterprises to pollute the environment or waste natural resources by setting more rational prices for

energy and raw materials and by charging appropriate fees for emission of pollutants. But they have been dragging their feet on price reform—wholesale and retail price reform have been postponed indefinitely—because it entails substantial social and political costs.

We see little prospect of significant progress in economic reform in the near term. As a result, industrial pollution will almost certainly increase. The Soviet leadership will be motivated to take serious action only in instances when an increase in disease, mortality rates, and lost workdays related to environmental causes demonstrably affects large numbers of the population. Moscow is likely to concentrate its attention on the most critical cases, and the worst facilities probably will be retrofitted or moved outside heavily polluted urban areas. Some will be closed or modified to nonpolluting output, but these measures will be limited by the available resources and by what the economy can tolerate in lost production.

Failure to provide the resources and incentives needed for environmental protection means that the economic losses resulting from pollution will grow, and, from the citizens' viewpoint, an already intolerable situation will worsen. Pollution will continue to damage harvests and forests, spoil agricultural land, and decrease fish catches. Waste will continue to be common in industry, health-care costs will increase, and lost workdays will lower productivity. More towns and villages will have to be relocated at considerable expense and social disruption. Pollution-related diseases will increase and mortality rates from these causes will rise. Many outdoor leisure activities will have to be curtailed. These issues could increase the chances for social unrest and political problems for Gorbachev.

Failure to clean up the environment at home could become a significant foreign policy issue because it will aggravate existing transnational and global environmental problems such as acid rain, the greenhouse effect, depletion of the ozone layer, and pollution of

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water bodies shared with other countries. Several countries in northern Europe, for example, would face increased pollution of the Baltic Sea. All countries would be affected by the greenhouse effect and depletion of the ozone layer. Transnational pollution, particularly acid rain, has already become a foreign policy issue in the Nordic countries. The recent signing of an agreement between Finland and the USSR for the mutual reduction of transborder air pollution resulted from Finnish concern about damage caused by emissions from Soviet enterprises on the Kola Peninsula and in the Leningrad area. Norway is seeking Soviet cooperation in reducing transborder emissions through bilateral meetings and visits of high-ranking Norwegian environmental protection officials to Soviet industrial enterprises responsible for pollution.

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