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CAROLE B. SZPUNAR

A PROPOSAL FOR UNITED STATES/POLISH COLLABORATION ON ENERGY AND THE ENVIRONMENT

Introduction

Argonne National Laboratory, a U.S. Department of Energy facility that is operated by the University of Chicago and located southwest of Chicago, Illinois, has proposed a collaborative effort by the United States and Poland to conduct applied research on energy and environmental topics of common interest. Through this collaboration, evaluative studies on energy and environmental assessment issues could be developed and implemented by Argonne and one or more sister institutions in Poland, which could lead to active research, development, and demonstration joint activities. The objective of this initiative is to produce strategies and options for review by Poland's decision makers that will result in the implementation of projects by Poland to correct and improve its energy and environmental situation.

Argonne's primary sister institution was expected to be chosen from a list of suggestions that included the Polish Academy of Sciences, the Polish Government Ministries of Industry and the Environment, the Polish Power Institute, and other designated universities or groups, or a combination of such groups. However, during Argonne Director Alan Schriesheim's trip to Poland in July 1990, the Academy of Mining and Metallurgy in Cracow was offered as a prospective sister institution to initiate and channel collaboration efforts. Subsequently, a memorandum of understanding was agreed to by both organizations.

The vision of this initiative is to bring together specific technical staff on both sides, at the interested, knowledgeable scientist/technologist level, to identify, characterize, and evaluate specific environmental and energy situations, to offer strategies for their resolution, and to evaluate jointly the ramifications thereof.

The concept of individual U.S./Polish collaborative research was proposed and presented to the Polish Institute of Arts and Sciences of America Annual Meeting in Washington, D.C., on June 16, 1990. Work was supported in part by the U.S. Department of Energy under Contract W-31-109-ENG-38.

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To work toward that vision, Dr. Carole B. Szpunar, Director of International Coal and Environmental Studies in the Environmental Assessment and Information Sciences Division at Argonne National Laboratory, and Professor Jerzy Niewodniczański, Director of the Institute of Physics and Nuclear Techniques at the Academy of Mining and Metallurgy, have been appointed by their respective organizations as co-coordinators/co-facilitators. Dr. William A. Buehring, Manager of Systems Analysis at Argonne, and Dr. Andrzej Kreft, Associate Professor at the Academy, have been assigned as deputy co-facilitators. A planning workshop was held in December 1990 as a means to initiate the sister-organization relationship and to serve as a starting point for a series of co-sponsored regional efforts to be held subsequently.

U. S. Developments

The U.S. Congress has already approved approximately $90 million in aid to Hungary and Poland in the "Support for East European Democracy" Act of 1989, commonly referred to as the SEED Act (U.S. Congress 1989[1]). A number of U.S. departments and agencies are involved — the Departments of State, Labor, and Energy, the U.S. Agency for International Development (AID), the Trade and Development Program, the Peace Corps, and the U.S. Environmental Protection Agency.

This legislation was, in part, prompted by President Bush's commitment in 1989 to aid Poland and other Eastern European nations in light of their sweeping political, social, and economic changes. This legislation was introduced and spearheaded by Senator Paul Simon and supported by Congressman Dan Rostenkowski, both of Illinois. Specific actions well underway include:

Establishment of an air quality monitoring network in Cracow,

Creation of a regional environmental facilitating center in Budapest,

The retrofitting of a coal-fired commercial power station in Cracow, and

The assessment and development of the capability within Poland to manufacture and modify boilers, furnaces, and other equipment, which would enable industrial facilities in Poland to use their fuels cleanly.

Why is Poland of Interest?

The lifting of the Iron Curtain in Eastern Europe has revealed some of the world's worst pollution-ravaged landscapes and industrial waste-induced health damage. This situation has initiated a variety of proposals and programs to

1. *Support for East European Democracy (SEED) Act of 1989,* U.S. Congress, U.S. Public Law 101-179 (November 28, 1989).

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assist these nations in dealing with the monumental task of restoring their environment. It is clear that these countries will have to overcome the legacy that their Communist heritage has left on their environment if they are to succeed in their endeavor to embrace the ideals of a democratically oriented, market-based economy. The environment has, therefore, become the focus of much of the current attention on Eastern Europe.

There is no doubt that the conditions in the Eastern European countries present a unique and challenging opportunity to the United States and the West to take a lead in offering assistance in the form of research cooperation and technical resources. But why should the focus be specifically on Poland? And why should the collaborative effort focus on the energy and environmental issues there? Poland is of interest on a number of fronts, which are briefly described below.

Energy

Domestic Coal Production Dependence

Poland exhibits a high dependence on domestic coal production for primary energy consumption and for employment purposes. More than 93 percent of the energy produced in Poland comes from coal and lignite, and more than 80 percent of the energy consumed also comes from coal and lignite. Moreover, 98 percent of the electricity generated in Poland is derived from coal and lignite.

The Polish government's coal policy has called for the stabilization of domestic coal production, targeted at 195 million tonnes per year for hard coal and more than 80 million tonnes per year for lignite for 1990.[2] Although 193 million tonnes were mined in 1988, only 178 million tonnes were mined in 1989, and only 148 million tonnes were mined in 1990.[3] To increase hard-coal production to meet the levels called for by the policy would require considerable capital-investment outlays, which are simply not available. Thus, Poland has been incrementally extracting lignite from open-pit mines rather than hard coal from deep, underground mines.

Oil and Gas Imports Dependence

Aside from its coal, Poland has very meager energy resources. Poland's domestic gas production and reserves are highly dispersed, with recoverable

2. I. Gorst, "Gas and Nuclear Fuel Replacing Oil," *Petroleum Economist* (May 1987), pp. 174, 191-192.

3. "IEA Presents Perspective on Poland's Energy and Coal Future," *Coal Week International* (July 2, 1991), Vol. 12, No. 27, p. 1.

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reserves estimated at less than 165 million tonnes oil equivalent and spread over about 40 producing fields. Of the nonproducing but proven reserves, about 25 percent are estimated to be uneconomical because of excessive reservoir pressures and high sulfur content. Proven recoverable oil reserves are estimated at only 4 million tonnes and dispersed over about 60 small fields. (Considerable, but unquantified, resources of coal bed methane are also present.

Given such low reserves of oil and natural gas, Poland had remained dependent on the Soviet Union for all its oil and gas imports; these imports constituted more than half of its domestic consumption of gas and oil. Furthermore, investments in pipelines to enable importation of gas from the West have not occurred.

Nuclear Plan Deferment

Plans for nuclear power plant construction and operation in Poland had been postponed until recently, when the Polish press reported that the government canceled these nuclear plans altogether.[4] This cancellation/indefinite postponement may be attributed to financial and technical setbacks and the ever-increasing environmental awareness of the Polish ecological community and resulting public concern.[5] However, many energy planners in Poland consider nuclear power to be its most important long-term electricity generation option. Limitations on other energy options generally seem to leave nuclear-fueled power as the best of future options simply by default.

Electricity Capacity Coal Dependence

A large share of the domestic consumption of hard coal and lignite in Poland is used for electricity generation. Total installed electricity generation capacity in the public sector was 28.9 billion watts (GW) in 1988 with 62 percent hard-coal fired, 31 percent lignite fired, and the remainder derived from hydroelectric power. On the basis of 1988 capacity, it has been estimated that an additional 15.8 GW of new capacity will need to be commissioned by the year 2000.[6] This increase has been expected to be provided mostly by nuclear energy, with the rest derived from hard coal, lignite, and combined heat-and-power units. However, with the demise of the nuclear power sector in Poland,

4. "Poland: Cabinet Votes to Cancel Zarnowiec, Defer Nuclear," *Nuclear News* (October 1990), Vol. 33, No. 13, p. 77.

5 Gorst,...

6. Carole B. Szpunar et al., "Poland: An Energy and Environmental Overview," *United States Agency for International Development, Bureau of Science and Technology, Office of Energy. Report No. 90-12.* (Washington, D.C., October 1990).

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this increase is likely to be taken up by coal.

Inefficient Energy Use

Poland's use of energy is very inefficient compared with western standards. Energy intensities for Sweden, the United States, and Poland, measured in megajoules (MJ) per unit of gross national product (GNP), are 8.6, 19.3, and 26.9 respectively.[7] The disparity between energy intensities in market-oriented economies (MOEs) and centrally planned economies (CPEs) are attributed, in part, to obsolete technologies and maintenance practices in the CPEs, greater emphasis on manufacturing rather than basic materials in the MOEs, and larger service sectors in the MOEs.

The Polish electric power generation system (as most of its other energy-consuming sectors) is characterized by high energy inefficiency. Efficiency for fossil-fueled electricity generation units in 1986 ranged from 21 percent to 36 percent, with 50 percent of such units averaging less than 30 percent.[8] Losses in electricity transmission and distribution are also high in Poland, accounting for almost 11 percent of the electricity derived from the public supply system. Internal power consumption in public power stations is also much higher than other nations (7.2 compared to 6.5 percent), despite the fact that desulfurization and other pollution-control systems on power plants are virtually nonexistent in Poland.[9]

Environment

Deteriorating Air Quality

Poland is a major emitter of SO_2 (sulfur dioxide), ranking seventh in the world generation of this pollutant. A steady deterioration in Poland's air quality is accompanied by frequent smog episodes. The highest SO_2 emissions are recorded in the vicinity of large power plants and industrial centers in Upper Silesia, especially the Cracow-Katowice region, and west/southwest of Warsaw, as evidenced by the thick soot emanating from the

7. A. B. Lovins, "Energy, People, and Industrialization," in *Energy Technologies for Reducing Emissions of Greenhouse Gases, Proceedings of an OECD/IEA Experts' Seminar* (Paris, April 1989).

8. N. Bhatti and C. B. Szpunar, *An Environmental and Energy Overview of Poland.* Air and Waste Management Association 84th Annual Meeting and Exhibition (Vancouver, British Columbia, Canada, June 1991).

9. *Poland: Reform, Adjustment, and Growth Annex. IV: Energy Report No. 6736-POL,* (Washington, D.C.: World Bank, 1987).

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steel mills (see Figure 1, p. 33). The majority of SO_2 emissions in Poland (66 percent) result from the production of electricity and industrial energy use, which are obtained almost exclusively from coal and lignite.[10]

Nitrogen oxide (NO_x) emissions are also relatively high in Poland. Unlike most other industrialized nations, however, most of these emissions result from stationary sources, with a relatively small contribution from the transportation sector.[11] The major stationary sources responsible for NO_x emissions in Poland are coal-fired power plants and coal combustion for heating. Moreover, NO_x emissions are projected to increase substantially over the next decade, particularly from the transportation sector.[12]

Given its large reserves of coal and lignite resources, its accelerating demand for energy, and its significant deficiency of hard currency, Poland is and will continue to be heavily dependent on these indigenous resources for most of its energy needs. At the same time, as Poland continues to draw on these coal reserves, the quality of the coal used is expected to become poorer and poorer, thus necessitating combustion of greater quantities of coal to obtain the same amount of useful energy, unless more efficient combustion is effected. These factors, along with increased reliance on old and inefficient industrial and power plants with little or no pollution controls, ensure that Poland will continue to be a heavy emitter of air pollutants.[13]

Contaminated Water Supply

Although air pollution problems, particularly air pollution crises in urban areas, have received considerable attention in recent years, it is generally believed that the most critical environmental problem in Poland is water quality. Untreated human sewage is commonly discharged into rivers and lakes, and the volume of such wastes is estimated to be approximately 2 billion m^3 (Gm^3)/yr.[14] Industrial and mining wastes and agricultural runoff

10. C. Agren, "Poland: Towards Betterment," *Acid News* (1988), No. 2, pp. 3-6.

11. J. M. Pacyna, *NO_x Emissions from Stationary Sources in Eastern Europe in 1985,* (Lillestrom, Norway: Norsk Institute for Luftforskning, 1988); and S. Larssen, *NO_x Emissions from Gasoline and Diesel Oil Combustion in Mobile Sources in Europe, 1985,* (Lillestrom, Norway: Norsk Institute for Luftforskning, 1989).

12. Agren,...

13. Bhatti and Szpunar,...

14. S. J. Kabala, "Poland: Facing the Hidden Costs of Development," *Environment* (1985), No. 27, pp. 6-13, 37-42.

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FIGURE 1 Sources of Coal and SO_2 Emissions in Poland

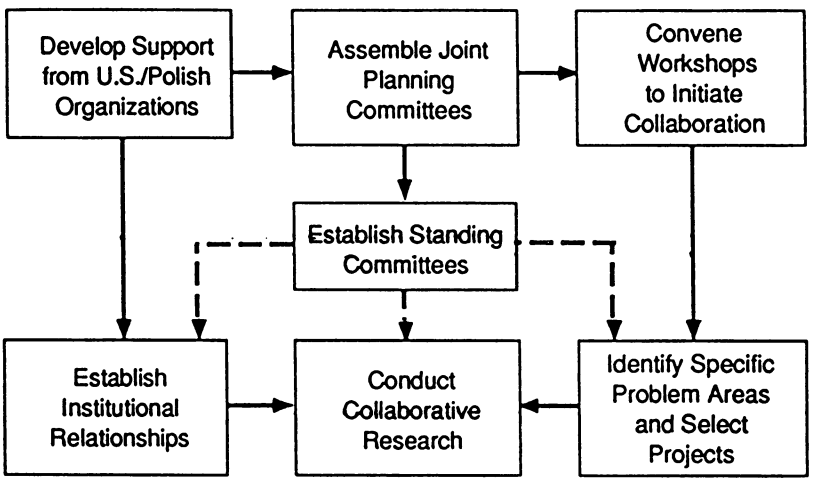

FIGURE 2 Stages in Developing a Collaborative Effort

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also add to the degradation of Poland's waterways. The salinity of coal mine wastes continues to increase. And thermal pollution from power-generating plants often disrupts aquatic ecosystems because of changes in water temperatures and mixing patterns in affected water bodies.[15]

Thus, Polish ground and surface waters have become contaminated extensively with domestic and industrial wastes. More than 78 percent of the lakes are polluted beyond most acceptable standards. Two-thirds of the water has been judged unfit, not only to drink, but for industrial use! And the Baltic Sea, having seen high levels of pollution for years, is deemed unfit for recreational use.

Soil Contamination

It has been relatively recently that damage to agricultural resources, particularly crops, has been attributable to pollution. In Poland, 65 percent of the land is classified as agricultural and almost one-third of the population is involved in farming.[16]

As a result of environmental pollution, it is estimated that 33 percent of Poland's food supply is contaminated;[17] in Upper Silesia, 25 percent of the crops grown are considered unfit for human consumption.[18] And the government has considered banning vegetable growing in the Silesian region of Poland because such high levels of lead and cadmium are contained in its soils. Lead and cadmium are probably deposited in the soil either directly, through industrial and power plant emissions, or indirectly, through acid-induced mobilization in the soil.

Forest Damage

One of the most dramatic impacts of pollutants, particularly air pollution, is evident in the forests. Widespread and extensive damage to forest resources has been observed in much of Central Europe. Reports estimate that up to 50 percent of the trees in Poland are badly damaged and another 17 percent are harmed to some extent, the most notable damage being found along the Czechoslovakian border just northeast of the Carpathian Mountains.[19] In

15. Bhatti and Szpunar,...

16. Bhatti and Szpunar,...

17. J. McCormick, *Acid Earth* (London: Earthscan Publications, International Institute for Environment and Development, 1985).

18. S. Rosenbladt, "Is Poland Lost? Pollution and Politics in Eastern Europe," *Greenpeace* (November-December 1988), pp. 14-19.

19. L. Tye, "The East Bloc's Dirty Secret," *The Gazette* (January 20, 1990), p. B. 6.

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Upper Silesia, where the highest densities of power generation and industry are located, all the forests appear to be damaged to some degree.[20] Economic loss to the forestry industry alone has been estimated at U.S. $1.5 billion annually.[21] In the Białowieża Forest in northeast Poland, which houses a herd of European bison (the largest remaining herd on the continent), 100-year-old trees are threatened by runoff from a chemical plant.

Human Health Impacts

Much of the recent concern about environmental degradation in Eastern European countries has been in response to its potential impact on human health. The high levels of production of air and water pollutants coupled with the large population density of this area place significant numbers of people at risk from the dangers of pollution. This situation is especially true in large portions of Poland, where a commitment to rapid industrial development, a high level of energy consumption, a lack of fiscal resources for pollution control, and the fact that a large proportion of the population live in urban centers (60 percent of the total population) have intensified the health-related hazards of high pollution levels.

Upper Silesia, along with Cracow, Rybnik, Legnica-Głogów, and Gdańsk, have been officially designated as "areas of ecological disaster." In Upper Silesia alone, it has been estimated that one million people are living in conditions that are a daily "health hazard."[22] The residents of Upper Silesia have been observed to have 15 percent more circulatory illnesses, 30 percent more cancer cases, and 47 percent more respiratory illness than people in the rest of Poland, probably as a result of these conditions.[23] In addition, retardation in children has also been found to be greater in Upper Silesia than in other parts of the country. In fact, 50 percent of Poland's schools for the mentally retarded are located in Katowice, in the heart of Upper Silesia. Furthermore, 35 percent of the children and adolescents in Katowice have been observed to have symptoms of lead poisoning and high concentrations of cadmium. This observation should not be surprising, since lead and cadmium levels in the soil in parts of this region are the highest ever recorded anywhere

20. T. Przybylski, "Ecological Catastrophe in Katowice," *Acid News* (1989), No. 3, p. 5.

21. M. G. French, *Clearing the Air: A Global Agenda* (Washington, D. C.: Worldwatch Institute, Paper 94, 1990).

22. Jędrychowski and Krzyżanowski, "Ventilatory Lung Function and Chronic Chest Symptoms among the Inhabitants of Urban Areas with Various Levels of Acid Aerosols: Prospective Study in Cracow," *Environmental Health Perspectives* (1989), No. 79, pp. 101-107.

23. S. J. Kabala, "The Economic Effects of Sulfur Dioxide Pollution in Poland," *Ambio* (1989), No. 18, pp. 250-251.

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in the world.[24] In Poland as a whole, 10-15 percent of the student population have been found to be chronically ill, and much of this illness is considered a direct result of environmental degradation.[25]

Life expectancy, which normally increases as a country develops industrially and as individual personal lifestyles in a society become more affluent, has decreased as a result of rising industrial-related illnesses. As an example, the life expectancy of a newborn male dropped from 66.9 years in 1980 to 66.5 years in 1985.[26] As another example, life expectancy for a 30-year-old male was 71.7 years in 1965; in 1987, it dropped to 69.7 years. Upper Silesia is perhaps the most severely affected area. Males in southwest Poland have even lower expected lifespans — on the order of two years less than their fellow countrymen.[27]

Materials Damage

Damage to man-made materials from air pollution is also common in many urban areas in Poland. Extensive damage to cultural resources and architecture has occurred, with the most dramatic effects being observed in Cracow (one of the few cities in the area to survive World War II intact). Because of its presence downwind from the industrial centers of Upper Silesia and its position at the bottom of a humid valley, it has become one of the most heavily polluted cities in Europe. Cracow's medieval buildings and monuments are corroding.[28] Its city walls and roofs are weakening.

Katowice is also suffering from considerable damage to its buildings and other man-made structures. In many areas, railroad tracks are so corroded that trains cannot travel faster than 25 miles per hour.[29] Unfortunately, it is likely that damage to man-made materials and structures in other urban areas either is or will probably become as severe as in Cracow and Katowice, since ambient air pollution levels in many parts of Poland are already high enough to cause material damage.

24. Kabala, "Poland: Facing the Hidden Costs...."

25. Tye,...

26. Kabala, "Facing the Hidden Costs...."

27. I. Laas, "Poland's Environmental Problems Called 'Severe'," *Journal of Air and Waste Management Association* (1990), No. 40, pp. 249-250.

28. B. Aniansson, "Stopping our Cultural Heritage from Crumbling," *Acid Magazine* (1988), No. 6, pp. 14-16.

29. McCormick....

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Why Choose Poland to Launch a Joint Initiative?

The drive to industrialize and rapid urbanization have left Poland with polluted air and contaminated water supplies, which have resulted in its population suffering from more pollution-related illnesses and having shorter lifetimes. Steady deterioration in air quality, with frequent smog episodes, is ever present. Ground and surface waters continue to be contaminated with domestic and industrial wastes. Despite these problems, Poland still remains reliant on poor-quality domestic coal and lignite as almost its only source of energy.

The changing political, social, and economic climate in Eastern Europe presents a unique opportunity for the United States to take a leading role in offering Poland alternative environmental strategies through cooperative research. Moreover, the assessment of the Polish energy and environmental situation could serve as a prototype for all of Eastern Europe.

The interest of the U.S. Congress in helping Poland and Hungary is evidenced by the 1989 SEED Act. By enacting this legislation, Congress has indicated its interest in assisting in the democratization of Poland and Hungary and has enabled the United States to take advantage of a well-timed opportunity to take a lead in offering its research cooperation and vast resources to help Poland solve its environmental problems and implement new energy applications.

Coal-producing states, such as Illinois, have particularly applicable technology and expert human resources that could significantly augment the Polish research community's efforts to clean up Poland's environment and use its coal energy more efficiently. Coal miners, coal geologists, and coal petrographers who work in southwestern Illinois underground coal mines have interests in common with their Polish counterparts; they offer brotherhood and the potential to share their expertise about coal mining and coal beneficiation. The Chicago area, where Argonne National Laboratory is located and where ties to Poland are very strong, is the home of industrial, manufacturing, financial, and academic leaders interested in and concerned about Poland's well-being and future.

Moreover, Argonne has established a strong network of personal contacts through (1) its long-term electricity planning and pricing studies and its related environmental impact analyses for the World Bank and the United Nations Development Programme (UNDP); (2) its well-established and perennial training of foreign nationals for the International Atomic Energy Agency (IAEA) on components of Argonne's Energy and Power Evaluation Program (ENPEP), an integrated energy/environmental planning package that is designed for the personal computer; and (3) its recent efforts to inform Polish embassy personnel, Polish government ministers, their staffs, and interested academicians and researchers in the universities, research institutions, and the

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Polish Academy of Sciences.

Formalization of a Joint Collaborative Effort

To help the reader envision the continued formation of the joint collaborative effort already initiated and described in this article, Figure 2 illustrates the stages of development for structuring such an endeavor.

Step 1: Continue to develop and marshal the support and cooperation of U.S. and Polish government agencies and private research institutions. This support — financial, political, social, etc. — will help to facilitate the establishment of long-term institutional relationships.

Step 2: Continue to identify knowledgeable, expert, technical contributors from the United States and Poland to serve as members of joint planning committees. (These technically oriented individuals may serve as the core members in standing committees.)

Step 3: Convene various topical workshops to bring together individual scientists and technologists to identify and discuss which specific problem areas would merit collaboration on this scale.

Step 4: Screen and cull the number of worthy collaborative projects, selecting those projects that meet budget constraints and that can be addressed on the basis of current and likely funding and prospects for successful early implementation.

Step 5: Foster, focus, initiate, and conduct the collaborative research. The results of this collaborative research performed between individual research teams would be offered to Polish and U.S. government bodies and then to industries to apply thereafter.

The support developed from the U.S. and Polish organizations, the establishment of the standing committees, and the actual ongoing bilateral collaborative research would continue to pave the way to establishing long-term institutional relationships between the United States and Poland.

Topics of Interest

This U.S./Polish joint initiative involves individual research on topical areas of mutual interest. This endeavor could include the survey, modeling, assessment, and research of specific topics. In doing so, the initiative helps to advance strategies that lead to subsequent policy implementation. Some of the study areas that are promising topics of research are listed below. They cover four broad areas — energy, environment, health, and natural resources.

Energy: Energy conservation, efficiency, planning, production, and technology applications;

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Environment: Increased focus on environmental issues such as acid rain, air quality, global climate change, water quality, hazardous wastes, and site reclamation and cleanup strategies;

Health: Birth defects, demographics, risk assessment, occupational health and safety, and public health; and

Natural resources: Long-term site reclamation activities involving croplands, forests, lakes and rivers, minerals, and wildlife.

In contributing to the proposed initiative, Argonne National Laboratory has definitive, proven, interdisciplinary, and long-standing expertise on which to draw upon in areas such as the following:

Development and application of integrated models for energy and environmental analysis,

Development and analysis of environmental control programs,

Application of techniques for site-specific environmental impact assessment and remedial action planning,

Assessment of opportunities and mechanisms for technology transfer, and

Natural-resource surveys.

Current/Continuing Activities

Argonne continues to be active in a number of programs involving Poland already underway prior to the establishing of this initiative. These activities include:

Developing and applying methods for electricity planning and pricing and related environmental-impact analysis, as part of the World Bank/UNDP Energy Planning Project (Dr. William A. Buehring);

Training foreign nationals on components or Argonne's Energy and Power Evaluation Program (ENPEP) for the IAEA (Dr. William A. Buehring); and with respect to the U.S. Department of Energy's Clean Coal Technology Program;

Disseminating an integrated energy and environmental overview of Poland [published as a U.S. AID report (Szpunar et al. 1990)]; and

Preparing an inventory of utilities and large industrial plants to assist in U.S. AID's project selection process (Dr. Carole B. Szpunar).

Argonne is also committed to seek and secure funding for a series of co-sponsored regional efforts, which would identify specific problem areas and foster the development of a host of specific topics for subsequent collaborative research activities, the U.S./Polish Initiative.

To advance this initiative, the following action/implementation steps have been identified and are being pursued as a means to achieve a working, successful collaboration.

Marshal the support and cooperation of U.S./Polish government agencies

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and research institutions;

Solicit support and cooperation from the U.S. Congress, U.S. government departments and agencies, and private organizations like the Polish Institute of Arts and Sciences of America;

Establish a series of regional/topical workshops to identify and characterize specific problem areas, leading to near-term corrective measures by the government of Poland; and

Begin to actively cooperate and collaborate in selected research areas of common interest and concern.

Update on Status

Members of the energy and environmental assessment technical staff at Argonne National Laboratory met with members of the Polish Academy of Mining and Metallurgy and other Polish counterparts in Cracow in December 1990. The objectives of this environmental and energy planning workshop and subsequent activities include:

To serve as a discussion forum (a starting point) which might result in a series of regional efforts (regional/topical workshops) to identify specific problem areas and develop a variety of individual topics for subsequent joint collaborative research activity;

To select particular environmental and energy issues and to initiate joint collaborative studies and research on these issues, involving numerous expert researchers from Poland and the United States and focusing on the environmental impact of energy production and consumption; and

To ultimately lead to Poland's phased implementation of corrective measures to ameliorate its environmental shortcomings.

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