Working Paper

Heavy Metal Pollution and Policies for Restructuring the Iron and Steel Industry in Poland

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Abstract

This study is part of a three year Industrial Metabolism Project entitled "Regional Material Balance Approaches to Long-Term Environmental Policy Planning" at IIASA which focuses on heavy metal pollution in the Black Triangle-Upper Silesia region of Poland. This report examines the economic importance of the iron and steel industry in the Katowice region, and its impact on heavy metal pollution. Environmental policies in Poland for limiting the emission of heavy metals and maintaining air quality standards are not sufficiently enforced to reduce heavy metal pollution in the region. In addition, limited progress has been made to date in privatizing the largely state-owned steel sector in Poland, with negative consequences for environmental regulation and the reduction of heavy metal pollution. In the absence of government action to implement a sector wide program for restructuring the iron and steel industry, restructuring has proceeded on a firm by firm basis with varied results. To mitigate the emission of heavy metals from the iron and steel industry, a number of policy options are discussed, including government policies for facilitating modernization, for financing needed investment, and for improving environmental regulation.

Contents

Introduction

Purpose of Study

This study was commissioned by the International Institute for Applied Systems Analysis (IIASA) in Laxenburg, Austria, as part of a three year Industrial Metabolism Project entitled "Regional Material Balance Approaches to Long-Term Environmental Policy Planning" which focuses on heavy metal pollution in the Black Triangle-Upper Silesia region of Poland. Within the Industrial Metabolism Project, IIASA has undertaken a comparison of the Ruhr River area and the Katowice district of Poland, both areas with extraordinary levels of heavy metal pollution. This report is part of that Ruhr-Katowice Policy Comparison Study.[1] The purpose of this report is to examine the economic importance of the iron and steel industry in the Katowice region, to assess its impact on heavy metal pollution, to describe the progress made to date in privatizing and restructuring the industry, and to evaluate current and potential future policies for limiting the industry's contribution to heavy metal pollution.

Sources and Methodology

Research for this report was undertaken using a variety of sources, including secondary sources published on the iron and steel industry of Poland, data provided by both the national and regional statistical offices, and other studies and articles available on Poland and the Katowice region in particular. In addition, the author made a trip to the Katowice voivodship (district) in June, 1996, to conduct interviews and gather information. In total,

[1]Juergen Blazejczak, Rhine/Black Triangle Policy Comparison Workshop. "Workshop Report." International Institute for Applied Systems Analysis. Laxenburg, Austria, 1995.

nine separate interviews were conducted with eleven people, including scientists and an attorney from the Institute for Ecology of Industrial Areas, representatives from regional and local government working in environmental regulation, scholars from the local technical university, industry representatives, and the plenipotentiary from the Ministry of Industry and Commerce responsible for overseeing the restructuring of the iron and steel industry in Poland (see list of interviewees in bibliography). Research undertaken in the Katowice voivodship also included a visit to the Baildon Steelworks located in the city of Katowice. Baildon Steelworks is an example of a steel company that has begun a significant program of restructuring, aimed largely at improving efficiency of production and diminishing environmental impacts of the steel making process. A brief case study of Baildon is included in the section on Restructuring and Privatization.

The report has been divided into four sections. The first discusses the economic background of the iron and steel industry in Katowice, its economic importance for the region and its production profile. The second section describes environmental protection in the iron and steel industry, including administrative jurisdictions, standards, fees and fines. The third section assesses privatization and restructuring of the industry to date, and its impact on heavy metal emissions. In the fourth section, an assessment is made of current and potential policy options for addressing heavy metal pollution from the iron and steel industry in Katowice.

I. Economic Background of the Iron and Steel Industry in Poland and Katowice

A. History and Economic Importance of the Industry

As in many industrialized countries, steel is a strategic sector in Poland, accounting for some 5% of all sales of Polish industry. Because the Polish steel sector provides the vast majority of steel inputs needed for domestic industrial production, especially mining equipment, ship and machine building, and construction, its restructuring is important for the development of Polish industry in general. The quality and price of Polish steel also impacts the international competitiveness of a range of other industrial products, especially in the electrical industry.[2]

The Katowice district of Poland has played, and will continue to play, an important part in the restructuring of the Polish steel industry. Katowice is the country's most important region for steel production, accounting for 17 of the country's 25 operating steel mills, and over half of its total steel production (see Figure 1). If all of southern Poland is considered, including the Katowice and Krakow districts and the entire Silesian coal field, 95% of the country's steel mills are located in this area. Steel clearly assumes a more dominant position in the economy of Katowice and southern Poland than in the country as a whole. Steel production in Katowice accounts for a disproportionately large share of the nation's production, relative to Katowice's area; the district produces over half the country's raw steel but comprises only 2.1% of Poland's total area (see Table 1). Steel is also a strategic sector for Katowice in terms of employment. Steel production accounts for over 5% of total

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[2]Barbara Pytel, "The Future of Industry in Central and Eastern Europe: The Polish Iron and Steel Industry," Institut Arbeit und Technik, Wissenschaftzentrum Nordrhein-Westfalen, 1995, 1.

Figure 1

The Location of Steel Mills in Poland

employment in Katowice, compared to some 3% of total national employment. In some municipalities, steel mills account for a much larger share of employment than in the region as a whole. Katowice also provides a disproportionately large share of Poland's electricity, non-ferrous metal and coke production relative to its area and population, and nearly 100% of the country's hard coal mining. The region's hard coal, coke and energy generation are important inputs for the steel industry, and help explain its historical location in the region. Though coke and coal-fired electrical power are available in abundance in Katowice, the region is far from sources of iron ore in Ukraine, as well as deep sea ports for low cost transportation of steel exports in the north.

Table 1

A Statistical View of Katowice: 1994

	Katowice Voivodship	Poland	Katowice share in Poland (%)
Population (million)	3.94	38.6	10.2
Land Area (km2)	6,650	312,683	2.1
GDP			20
Employment in Metallurgy (ferrous and non-ferrous) *	74,700	162,500	46
Raw steel production (million tons/year)	6.3	11.2	56.3
Electric Energy Production			22.1
Coke Production (million tons/year)	4.6	13.9	33
Hard Coal Mining (million tons/year)	129.8	132	98
Zinc and Lead Production			100

Source: Polish and Katowice Statistical Yearbooks, 1994, 1995.
* Employment figures from 1993.

B. Profile of the Iron and Steel Industry in Katowice

Katowice Voivodship's 17 steel mills comprise a wide range of steel making capacity and product lines (see Table 2 and Figure 2). Together, these mills produce some 6 million tons of raw steel annually, as well as several million tons of processed steel products. Steel production in Katowice accounts for nearly 27% of total industrial production in the region,

second only to energy generation. The share of steel in industrial production has remained stable throughout the 1990s. If non-ferreous metals are included, production of ferrous and non-ferrous products is the largest single industrial sector of the Katowice economy, and should be a target for industrial restructuring aimed at lowering levels of pollution in the region.

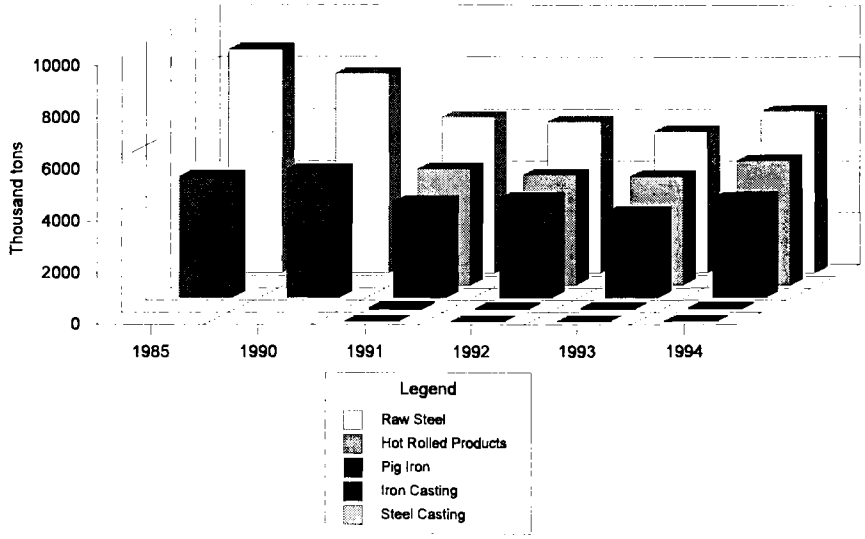
Table 2:

Iron and Steel Production 1993: Katowice and Poland
(in thousand tons)

Product	Katowice	Poland	Katowice share of Polish Production (%)
Pig Iron and Ferroalloys	3,299	6,298	52
Raw Steel	5,484	9,939	55
Hot rolled products	4,215	7,632	55
No. of Steelworks	17	25	68

Source: Statistical Yearbooks for Poland and Katowice, 1994.

Figure 2: Katowice Steel Production



Source: Katowice Statistical Yearbooks 1992, 1994, 1995.

Production at Katowice's steel mills has undergone significant reorganization since the mid-1980s when new investment was made to modernize the facilities, with positive effects in terms of reducing pollution. Since 1985, half of the district's highly polluting iron blast furnaces for making pig iron have been closed down, with capacity only slightly reduced (see Table 3). In addition, 62% of the open hearth (Siemens-Martin) furnaces for production of raw steel have been closed since 1985, providing significant benefits in terms of reductions in heavy metal emissions. Open hearth furnaces in some cases have gradually been replaced by electric arc and induction furnaces.

Table 3
Steel Production in Katowice By Number and Type of Furnace
(Number of furnaces and thousand tons produced)

	1985	1990	1991	1992	1993	1994
Number of Iron Blast Furnaces	10	7	7	5	5	5
Pig Iron and Ferroalloys from Iron Blast Furnaces (thousand tons)	4,768	4,952	3,710	3,849	3,399	3,857
Number of Open Hearth Furnaces	45	37	32	27	23	17
Steel from Open Hearth Furnaces (thousand tons)	3,504	2,187	1,576	1,299	968	918
Number of Electric Arc Furnaces	18	17	17	21	21	17
Number of Electric Induction Furnaces	6	6	6	8	8	9
Steel from electric arc and induction furnaces (thousand tons)	864	883	766	609	922	1,133

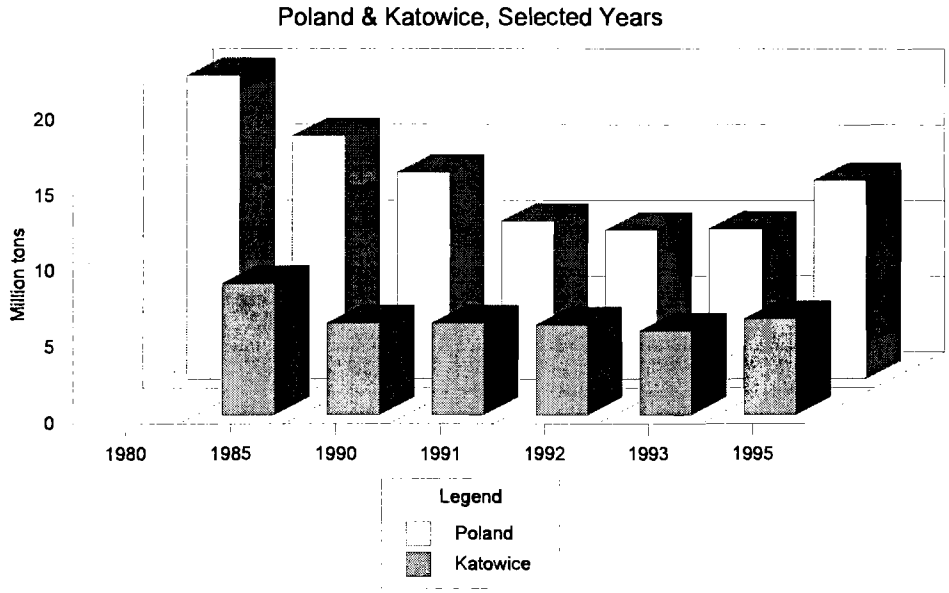
Source: Katowice Statistical Yearbooks 1992, 1994, 1995

Katowice is home to the country's largest single mill, Katowice Steel Works, developed after World War II. Katowice Steelworks is one of only two fully integrated steel mills in the country, meaning that its facilities include the entire range of steel production

from the processing of iron ore to finished steel. Though Katowice district accounts for the majority of Poland's steel production, many of its mills are smaller than those elsewhere in Poland. The scattering of some 17 mills throughout the highly populated district may contribute to health hazards associated with heavy metal emissions by causing unnecessary replication of certain production processes and by giving rise to other inefficiencies, including inefficient use of energy, transportation, and other resources. While total atmospheric heavy metal emissions in Katowice may be higher due to the fragmentation of steel production than under conditions of economic efficiency, the proliferation of many small mills may reduce the overall *concentration* of emissions and thus diminish some of their negative environmental impacts.

Katowice's history of steel production follows closely that of the nation as a whole. The Polish government developed its steel industry heavily after World War II with the goal of making the country self-sufficient in terms of raw steel; any specialized imports of processed steel were expected to be balanced by exports. To this end, the communist government of Poland launched a massive effort to expand Polish steel production from its historical base dating from the industrial revolution of the mid-1800s. This effort increased total raw steel production from a level of 2.5 million tons in 1952 to 11.8 million tons in 1970, and a peak of nearly 20 million tons in 1980. Since 1980, investment in the steel industry has declined, and with it, the level of production (see Figure 3). During the period of rapid macroeconomic reforms of 1989-90, Poland adopted market based pricing of inputs and increased energy prices, though they are still partially subsidized. These changes, combined with a dramatic drop in domestic demand (and a decline in exports to former Eastern bloc

Figure 3: Raw Steel Production*



Source: Pytel, 1995; MBM East European/CIS Supplement June 1995; and Polish and Katowice Statistical Yearbooks, 1994, 1995.
* Figure 3 contains statistics for selected years drawn at uneven intervals-

countries) as well as increased competition from imports, caused Polish steel production to fall precipitously to a low of 9.8 million tons in 1992.

Following national trends, steel production in Katowice also declined during the 1980s. In 1989, production fell off more sharply and reached its nadir in 1993 at 5.5 million tons. After that time, production of raw steel in Katowice slowly climbed back to its current level of 6.3 million tons in 1995. Steel production in Poland is not expected to return to levels during the boom years of the late 1970s and early 1980s, when investment in the sector was at a high and methods of production--such as open hearth furnaces-- were used that are currently unacceptable for environmental reasons. After the liquidation of many highly polluting and inefficient production facilities, annual steel production in Poland stabilized in

1995 at a more sustainable level of approximately 13 million tons and is expected to remain there for the foreseeable future.[3]

C. Enterprises and Main Products

Poland's largest and most modern metallurgical facility, Katowice Steelworks, includes massive furnaces with a capacity of 3,200 cubic meters and oxygen converters with a capacity of 350 tons. This steelworks alone is capable of producing 4.5 million tons of raw steel per year. The remaining steel mills in Katowice are of a smaller scale, and produce a more limited range of products, including raw steel, hot rolled products, pipes, ferroalloys and tubes (see Table 4).

[3]"A thoroughly modern Polish steel industry?" Metal Bulletin Monthly East European/CIS Supplement, June 1996, 14.

Table 4: Steel Mills in Katowice Voivodship 1995

Name of Company	Principal Products
Huta Baildon	Alloy steels, hot rolled & forged bars, cold rolled narrow strips, wires, welding electrodes
Huta Batory, SA*	Carbon & alloy steels, hot rolled & forged bars, seamless pipes, plates, forgings
Huta Buczek, SA	Alloy steel, seamless & welded pipes & tubes
DUO-STAL Ltd.	Raw steel (open hearth), blooms, billets
Huta Ferrum SA	Longitudinal 7 spiral weld pipes, fuel tanks
Huta Florian	Steel bars, sections, hot band, narrow cold strips, galvanized color-coated coils & sheets
Huta Jednosc SA	Raw steel (open hearth until 1997), seamless & cold drawn tubes & pipes
Huta Katowice SA	Coke, pig iron, steel (converters), bars, hot rolled sections, railway rails, steel casting
Huta Kosciuszko	Steel bars, hot rolled sections, railway rails
Huta Labedy	Raw steel (electric furnace), hot rolled sections, universal plates, mine support arches
Huta Laziska	Ferroalloys (Fe-Si, Fe-Cr HC, Fe-Si-Mn, Fe-Al) multi-component alloys, silica and chromium dusts
Huta Laziska	Raw steel (electric furnaces) hot rolled bars, forgings, ship crankshafts, rolls, machine parts
Huta 1st of May	Railway axles, wheel centers, monoblock wheels, tires and wheel sets, forgings
Huta Pokoj	Blast furnace ferromanganese, plates, hot rolled sections, steel structures
Huta Zawiercie SA	Raw steel (electric furnaces) bars, rebars, sections, rods, rod processing
Huta Zabrze SA	Heavy machinery, ladles, cranes, iron and steel castings, steel structures
Huta Zygmunt SA	Heavy machinery for metallurgy & power industry, castings, forgings, steel structures

*SA is Polish for joint stock company. Many joint stock companies in Poland are still under partial state ownership and are awaiting further privatization.
Source: Metallurgical Chamber for Industry and Commerce, Katowice, 1995.

Employment and Labor Productivity

The iron and steel industry is not only an important industry in Katowice for its large contribution to the region's total industrial production, but also for its significant share of regional employment. In 1993, employment in the iron and steel industry in Katowice accounted for 5.2% of total regional employment, the largest source of employment of any industrial sector. In addition, the steel sector generates additional employment in industries which provide its inputs, such as coal mining and energy production, as well as in manufacturing industries which process steel into finished products. Employment in the Katowice steel industry has been steadily falling since the late 1980s. Declines in employment have been less sharp than declines in production, leading to diminishing rates of labor productivity. Labor productivity began to increase again in 1993 due to an increase in production, but has still not reached levels comparable to pre-1990, which were still quite low compared to Western standards.

Continued restructuring of the Katowice steel industry will require a reduction of employment in the sector due to its historic levels of over employment. Labor redundancy in iron and steelworks stems from the traditionally low cost of labor relative to other inputs, the tendency of firms under central planning to hoard workers, and the lack, continuing to today for some firms, of hard budget constraints. A government-commissioned study of the Polish steel industry by a consortium of Canadian advisors and consulting firms recommended in 1992 that total employment in the steel industry be cut by over half, to approximately 50,000 workers. Targets in the study were later accepted by the Polish parliament as part of a national restructuring program. During 1991-93, employment in the sector fell by approximately 32,000, but it still remains above levels recommended by the study, at

approximately 95,000 workers.

Table 5
Employment in the Iron and Steel Industry in Katowice and Poland

	1985	1990	1991	1992	1993	1995
Poland	--	--	126,100	119,300	109,400	95,000
Katowice	81,000	68,400	64,700	63,300	61,200	53,300
Katowice share	--	--	51%	53%	56%	56%

Source: Statistical Yearbooks for Poland and Katowice 1992, 1994 and statistics from the Metallurgical Chamber of Industry and Commerce.

Declines in employment in the steel sector in Katowice have in general followed national trends, but Katowice has not shed labor as rapidly as other parts of Poland (see Table 5). The government's desire to control unemployment may have a secondary environmental effect by slowing the process of privatization, restructuring and thus efforts to modernize plants and reduce emissions. Data on employment for the region suggest that further declines in employment will be necessary to increase the sector's profitability and labor productivity. If Poland is to reach its accepted employment target for the steel industry of 50,000 workers, Katowice would need to shed approximately half of its employment in the sector, a prospect which could involve high social costs. Many of the region's steel mills are still state owned, while management is heavily influenced by workers' councils in place since the early 1980s. Katowice's traditional reliance on industry and the underdevelopment of the service sector could impede the process of labor market restructuring and the creation of alternative employment for redundant steel workers. The Canadian restructuring program recommended several policies to minimize social costs of unemployment including early retirement programs, a shorter working week, employee retraining, lump sum compensations

for job leavers, and alternative job creation programs.[4] In the absence of government funds to finance such programs, firms have relied only on voluntary reductions in employment to achieve current employment levels.

II. Environmental Policy and the Iron and Steel Industry

A. Contribution to Heavy Metal Pollution by the Iron and Steel Industry in Katowice

The iron and steel industry in Katowice is one of several industries that are collectively responsible for the vast majority of atmospheric heavy metal emissions in the region. By far the largest single source of heavy metal emissions in the Katowice region is energy production and heat generation. A total of 6,500 MW of capacity is currently in place in Katowice voivodship, all of which is based on combustion of hard coal.[5] The steel and non-ferrous metal industries are the second and third largest sources of heavy metal emissions, depending on the heavy metal considered. In both Poland as a whole as well as Katowice, the steel industry accounts for the second largest source of chromium, copper, lead, and zinc air emissions. The steel sector accounts for the third largest source of arsenic and cadmium emissions after the non-ferrous metal industry (see Table 6).

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[4]Pytel, 15.

[5]Anna Zawiejska, "The Guidelines of Air Protection Policy in the Katowice Voivodship," Unpublished mimeo, Voivodship Office, Department of Ecology, Katowice, October 1995, 2.

Table 6

Heavy Metal Emissions by Source Category
Katowice Voivodship 1992
(Kg/year)

Source Categories	As	Cd	Pb	Zn
Energy and Heat Production	7,107	12,912	62,173	229,457
Iron and Steel Production	940	785	80,450	260,115
Non-ferrous Metallurgy	1905	1368	71,690	101,639
Cement Production	-	-	61	79
Transportation	-	198	26,167	4,578
TOTAL	**9,952**	**15,263**	**240,541**	**595,868**
Percent Iron & Steel Production	**9.5%**	**5.1%**	**33.5%**	**43.7%**

Source: Stanislaw Hlawiczka, Institute for Ecology of Industrial Areas, IIASA Report, 1996 and author's calculations.

It is clear from the information in Table 6 that the iron and steel industry in Katowice is responsible for a very large share of lead and zinc emissions in the region, as well as a substantial share of arsenic and cadmium emissions. Though the energy sector is the largest single source of heavy metal emissions, reductions of emissions from the steel sector could significantly contribute to efforts to reduce levels of heavy metal pollution in the region.

Heavy metals are emitted into the air during the process of steel making in the form of dust particulates. The main heavy metals emitted during steel production, listed in order of descending importance, are chromium, used primarily in ferroalloys, zinc, lead, copper,

arsenic, nickel, and cadmium.[6] By far the most pollution intensive aspect of steel production in terms of heavy metal emissions is energy combustion, almost exclusively from burning hard coal, in which approximately 60-70% of heavy metal emissions in the steel sector are estimated to be released.[7]

Several other aspects of the steel production process are responsible for the remainder of heavy metal emissions in the industry. Of these, the production of pig iron and raw steel are most polluting. Sinter plants, in which iron ore is processed, are the greatest source of dust emissions in the steel making process. The second greatest source are open hearth furnace steel plants, which emit a large volume of contaminated dust into the air. Open hearth furnaces are an outmoded technology for raw steel production that is no longer used in Western Europe or the United States. Until recently, open hearth furnaces were common in Poland, but they are now slowly being phased out. Open hearth furnaces are particularly harmful sources of heavy metal emissions due to their extremely high energy intensity compared to other methods of production, and the difficulty of installing dust controlling devices in the open area of the furnace. Blast furnaces, which produce pig iron and ferroalloys, are also large emitters of heavy metals, though not as significant as open hearth furnaces. Electric arc furnaces and oxygen induction furnaces represent a small but increasing share of Polish steel production. These furnaces have a much lower energy intensity of production (see Figure 4), and are designed to facilitate the use of dust removal equipment to filter out heavy metal emissions. Further processing of steel into rolled and

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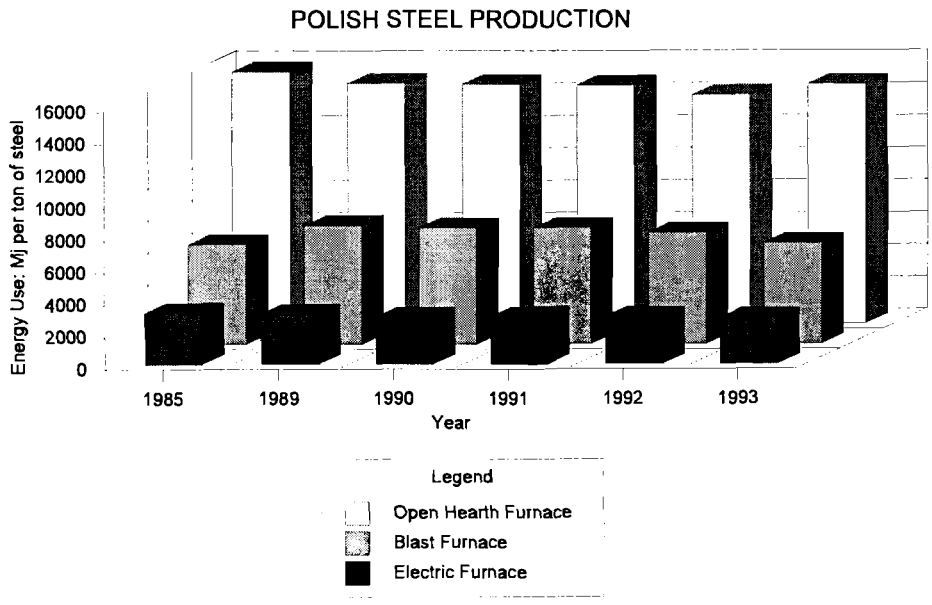
[6]Stanislaw Hlawiczka, "Polish Air Emissions Report," Institute for Ecology of Industrial Areas, Katowice, 1993.

[7]Stanislaw Hlawiczka, Institute for Ecology of Industrial Areas, Katowice, Interview, June 24, 1996.

Figure 4: Energy Intensity



Source: Pytel, 1995; MBM East European/CIS Supplement June 1995; and Polish and Katowice Statistical Yearbooks, 1994, 1995.
* Figure 3 contains statistics for selected years drawn at uneven intervals.

drawn products is in general a much less polluting form of production.

Due to a variety of factors, heavy metal emissions have declined since 1980 in Katowice. For some metals such as lead and zinc, emissions have declined by over half (see Table 7). The source of reductions in emissions is a matter of debate in the voivodship, with varying estimates of the influence of different factors, including the decline in industrial

production from 1990-92, intra-sectoral change such as technological improvements, and the liquidation of various open hearth plants and other highly polluting processes. In 1991 alone, for example, steelworks in Katowice shut down four open hearth furnaces (two at Huta Labedy, one at Huta Zawiercie and one at Huta Zygmunt) and one coke oven battery at Huta Zabrze.[8] As production stabilizes during the current economic recovery, further reductions in heavy metal emissions will need to be achieved through continued modernization and restructuring of the region's steel plants, with impetus for such changes in some cases coming from enforcement of environmental regulations. Modernization could follow closely the experience of the Ruhr Area, in which intra-sectoral change contributed most to the decline in heavy metal emissions.[9]

Table 7
Trends in Atmospheric Emissions of Heavy Metals in Katowice

(1992 emissions = 1.0)

	1980	**1985**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**
As	1.69	1.48	1.44	1.42	1.30	1.05	1.02	1.0
Cd	1.92	1.75	1.69	1.63	1.39	1.11	1.03	1.0
Pb	2.40	1.98	1.79	1.71	1.65	1.37	1.32	1.0
Zn	2.07	1.81	1.70	1.62	1.49	1.16	1.04	1.0

Source: Institute for Ecology of Industrial Areas, Department of Pollution, Katowice.

[8]Katowice Statistical Yearbook 1992, 95.

[9]Sander De Bruyn and Simone Schucht, "Industrial Transformation and Development of Heavy Metal Emissions in Northrhine-Westfalia: Decomposition and Material Flow Analysis," Working Paper WP-96-8, International Institute for Applied Systems Analysis, Laxenburg, Austria, 1996.

B. Legal and Administrative Framework for Environmental Protection in Poland

The Polish Environmental Protection Act of January 31, 1980 provides a legal definition of air pollution, but it does not specifically regulate levels of air emissions. Though a number of environmental laws have been passed by the Polish parliament since 1990, including the Forest and Nature Protection Acts of 1991, and the Geological and Mining Act of 1994, the parliament has not passed a separate law regulating air pollution. Rather, air quality standards and fees and fines for enforcing these standards have been issued by executive decree based on the Environmental Protection Act. The regulation and enforcement of air pollution standards are largely the responsibility of administrative bodies at the voivodship level.

A decree of the Ministry of Environmental Protection, Natural Resources and Forestry of February 1990 established permissable concentrations for a variety of air pollutants, including heavy metals, dust, nitrous oxide and sulfur dioxide.[10] The decree also specified authorities responsible for issuing permissable emission levels for point sources and established air pollution monitoring requirements for large polluters. In the case of some pollutants, air quality standards established in the decree are as strict or stricter than those of the European Union. Given limited resources of the district authorities and the high levels of pollution in industrial regions such as Katowice, it appears that Poland's standards are not being met or fully enforced in these areas. Standards for other pollutants are difficult to compare with those of the European Union (EU) because of different time periods for

[10]"Dziennik Ustaw Rzeczypospolitej Polskiej," No. 15, Warsaw, 14 March 1990, 181-184.

measuring concentrations in some cases. In the future, it is expected that Poland will need to harmonize its air quality standards with those of the EU in preparation for its application for full membership.

Based on the decree from the Ministry of Environment, administration of air emission regulations is executed at the voivodship, or district, level. Each voivodship in Poland has a similar administrative structure that includes a Voivodship Board of the State Environmental Protection Inspectorate, which is responsible directly to the Deputy Minister of the Environment, who is also the State Environmental Protection Inspector. The State Environmental Protection Inspectorate's (SEPI) competencies were broadened by the SEPI Act of July 1991. The SEPI's responsibilities, carried out in part by 49 SEPI offices at the voivodship level, include imposing fines for violation of environmental standards, ordering the stop of an activity considered hazardous to the environment, the prevention of licensing of activities not conforming to environmental regulations, coordination of the National Monitoring Network, and cooperation with other authorities, including Voivodship Departments of Environmental Protection, to exchange information on polluters.[11]

In addition to the SEPI, each voivodship has its own Department of Environmental Protection, and a Voivodship Environmental Fund (see Figure 5), both of which are responsible to the Ministry of the Environment. The Voivodship Department of Environmental Protection is responsible for issuing permits, collecting fees and fines, issuing administrative orders, measuring and monitoring pollution activities, and keeping records.[12]

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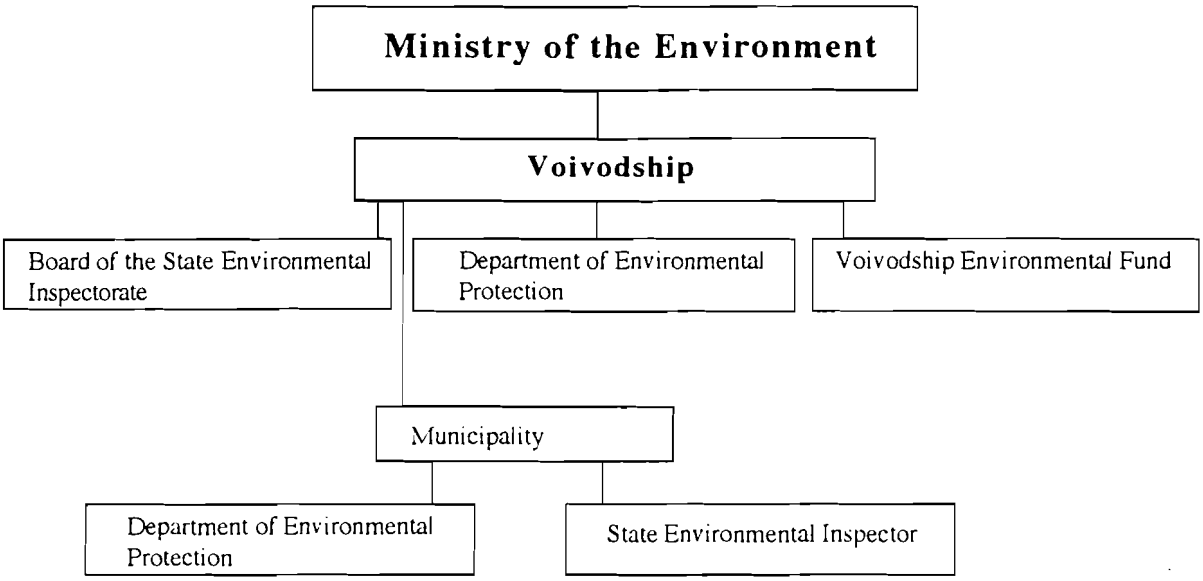
[11]Zurek, Janusz, ed., Environmental Protection in Poland: A guide-book on legal regulations, administrative procedures and institutions, Institute of Environmental Protection, Warsaw, 29, and memo from Rafal Kucharski, Jr., Institute for Ecology of Industrial Areas, Katowice, September 1996.

[12]Zurek, 9-11.

Figure 6: Poland's Administrative Structure for Environmental Regulation



A similar structure at the municipal level assists the voivodship with the collection of fees and fines and in some cases operates its own environmental funds. The district government representative, usually the voivodship Department of Environmental Protection, is responsible for issuing decisions on permissible air emission levels for individual point sources, including steelworks. These decisions are issued to ensure that the district complies with air quality standards established in the decree on air pollution from the Ministry of Environment.

The voivodship offices thus have the authority to set emissions standards for individual firms. In setting each firm's emission levels, the district takes into account the quality and quantity of pollutants discharged into the air, the technology used by the firm, the duration of operation each year, the pollution control equipment it has installed, and the range of dispersion of pollutants. Emission levels established by administrative decision can be adjusted in the case of a change in the quantity or quality of pollution, a change in standards concerning air protection, or the presence of new emitters in the region. [13] If a new emitter begins production in the region, the voivodship is entitled to change emission standards for each firm.

Though Poland regulates emissions of heavy metals into the air, it does not have standards for permissible levels of heavy metals in the soil. The only regulation relating to heavy metal deposition in the soil is an executive order from 1986 regulating use of sewage sludge for agricultural purposes due to its content of heavy metals and harmful bacteria.[14]

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[13]Rafal Kucharski, Jr. "Legal Aspects of Air Pollution Abatement in Poland," Institute for Ecology of Industrial Areas, Katowice, Poland, October 1995.

[14]Interview with Rafal Kucharski, Jr. Institute for Ecology of Industrial Areas, Katowice, Poland, June 25, 1996.

The use of sewage sludge on agricultural land is prohibited in certain protected zones, for example near water catchment areas and national parks. In addition, sewage cannot be applied on land that already contains a certain concentration of heavy metals (see Table 8).

Table 8

Heavy Metal Concentrations in Agricultural Soils Above Which Application of Sewage Sludge Is Prohibited
(In mg/kg of dry soil)

	Light Soil	Heavy Soil
Lead	50	100
Cadmium	3	3
Chromium	100	300
Copper	50	100
Nickel	30	100
Mercury	1	2
Zinc	200	300

Source: Institute for Ecology of Industrial Areas, Katowice.

The long-term nature of the heavy metal deposition, which in Katowice has occurred for over a century, and the difficulty of monitoring deposition and identifying a source of responsibility for high concentrations of heavy metals in the soil have complicated attempts at their regulation. The Industrial Metabolism Project at the International Institute for Applied Systems Analysis is focused in part toward furthering our understanding of how to effectively regulate heavy metal deposition.

In addition to maintaining their individual air emission levels, certain enterprises are subject to monitoring requirements. Firms discharging an excess of 800 kilograms per hour

of dust (or 1200 kilograms per hour of SO2), are required to install permanent monitoring devices. In addition, firms that have the capacity to discharge more than 100 kilograms per hour of dust or SO2 must sample their emissions twice a year at times agreed to with the district representative.[15]

To date, Poland's environmental protection policy for air pollution has involved setting air quality standards and emissions targets for individual firms. Poland has not yet moved to more comprehensive forms of regulation such as best available technology requirements, or restrictions on the use of harmful inputs or production processes. Such forms of regulation were used effectively in the Ruhr area to combat heavy metal pollution, and are common in Western Europe. As Poland moves increasingly toward membership in the European Union, it is likely that it will broaden its environmental policy to include such forms of regulation. The Environmental Minister for the European Union recently indicated that the EU is taking a harder stance on environmental policy in Central Europe in preparation for their application for full membership. Central European countries will be required to adopt comprehensive environmental policies, and fully harmonize their environmental regulations with those of the EU, as preconditions for joining the union.[16]

Fees and Fines

Poland has established a system of fees and fines to raise revenue and provide an economic disincentive to pollute. Fees are charged to entities for "use" of the environment in the form of a charge per unit of pollutant emitted into the air per year for any emissions that

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[15]Kucharski, Jr., 4.

[16]"EU to Central Europe: Clean Up," *International Herald Tribune*, September 27, 1996.

fall *below* the standards set for that entity. Firms are required to report to the voivodship representative the quantity and kind of all emissions for a given year by January 31 of the following year. Fees are then assessed and collected by the voivodship's Department of Environment. Fees charged for emissions are generally lower than the costs of abatement, as well as the real economic and environmental costs of pollution, and therefore do not provide a sufficient incentive for the firm to internalize the full costs of pollution.

In the Katowice and Krakow voivodships, the government recently doubled fees for air emissions compared to other voivodships in an attempt to improve their high levels of air pollution. Industry representatives have challenged the legality of this policy in court, claiming that standards should not be set according to administrative borders, but according to the emission intensity of individual plants. The conflict has stimulated debate over the best means for regulating air emissions. The situation in regions with large levels of air pollution, such as Krakow and Katowice, suggests that these areas could benefit from a tradable emissions permit scheme. Tradable permits can be effectively used in areas with a cluster of many and varied sources of pollution. Tradeable permits are an efficient means for attaining national or regional air emission standards by providing incentives for technological innovation and by rewarding firms for reducing emissions below the standards (see Policy Options section below).

Fines, which are levelled for any emissions that *exceed* emission standards set for the entity provide the major incentive to comply with air emission regulations. Fines are assessed at ten times the value of the regular fee for the pollutant in question, and are collected by the Voivodship Department of Environment.[17] Fees and fines collected by the

[17]Kucharski, Jr., 4.

voivodship are distributed to the National, Voivodship and Municipal Environmental Funds. Poland's National Environmental Fund, established in 1989, is supplemented by 49 Voivod and Gmina (municipal) environmental funds which are capitalized by pollution fees and fines, as well as by occasional grants from the state budget. Ten percent of fees and fines for air emissions collected by the voivodship are distributed to municipal (gmina) funds. Of the remaining funds, 40% are distributed to the national fund, and 60% remain in the voivodship's fund.[18] Total revenue of the national, regional and local funds amounts to approximately $450-500 million per year, and is used to provide grants and soft loans to enterprises or communities for environmental investments.[19] Several steelworks in the Katowice district, including the Baildon Steelworks, have received subsidized credit from the funds to finance pollution abatement technology.

Enforcement of emissions standards and the collection of fees and fines is complicated, however, by continued state ownership at many large industrial enterprises. State ownership predominates in nearly all of the steel mills in Katowice, and in many other industrial firms as well. Firms that are largely still state-owned lack the incentive, or are simply not forced, to pay fees and fines for pollution. Additionally, many of these firms are indirectly subsidized by the government through large tax arrears, which make paying environmental fines seem largely irrelevant. This situation, combined with limited resources and staffing at the district level, make monitoring and enforcement imperfect at best.

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[18]Interview with Maria Szczypior, Department of Ecology, Katowice Voivodship, Poland, June 27, 1996.

[19]"Strengthening Environmental Funds in Economies in Transition," Proceedings from the International Conference, Jablonna Palace, Poland, May 10-12, 1995.

III. Restructuring and Privatization of the Iron and Steel Industry

A. National Proposals for Restructuring the Iron and Steel Industry

Since 1990, the Polish government has put forward and accepted several proposals for restructuring the Polish iron and steel industry. These proposals, however, have fallen victim to frequent changes in national leadership and political disputes, with the result that none of the proposals has been implemented in its entirety. In the absence of a coordinated government program, individual steelworks, many of them still largely state-owned, have adopted their own, *ad hoc* policy of restructuring at the firm level. Improving the negative environmental impacts of the iron and steel industry, including heavy metal emissions, is one goal of policies for restructuring iron and steelworks, though it is assumed that a decline in pollution levels will largely be achieved by modernizing production facilities and lowering the intensity of energy and material inputs--efforts that also improve the economic efficiency of production, as well as the installation of "end of pipe" pollution control technology.

A brief discussion of the chronological development of government proposals to restructure the iron and steel industry will provide a context for understanding current restructuring efforts. The first attempt at rethinking Polish industrial policy by post-1989 governments came under Prime Minister Mazowiecki and Finance Minister Balcerowicz's strongly laissez-faire leadership of 1990-91. During Balcerowicz's "shock therapy" macro-economic reforms of 1990-91, the government's view on industrial policy was best articulated by the Minister of Industry and Commerce, who stated that "the best policy is no

policy at all."[20] In this period, Polish iron and steelworks, just as other industrial enterprises in the country, bore the brunt of rapid macroeconomic stabilization and the release of prices in the form of sharp drops in demand for their production.

In response to the concurrent declines in industrial production and the drop in living standards, a new, center-left government under Prime Minister Olszewski was inaugurated in the first half of 1992. The Olszewski government intended to reverse the laissez-faire approach to restructuring of Balcerowicz and create a sector-based industrial policy. Energy and capital intensive sectors especially were to be scaled back due to their economic inefficiency and environmental impacts. The government commissioned 70 sectoral studies on which it based sectoral restructuring programs, including the study of the iron and steel sector by the Canadian Consortium.

The Consortium's "Plan for the Restructuring of the Iron and Steel Industry in Poland Until 2002" was adopted by the Polish Government on December 1, 1992 as the basis for its restructuring program. In addition to recommending the modernization of production facilities, the Consortium called for scaling back annual production of raw steel to less than 12 million tons, a level that has since been criticized as too low. Representatives from the iron and steel sector quote a level of 13.5 million tons per year as more compatible with domestic demand and Poland's modernized production capacity.[21] In addition, the report called for a reduction in labor intensity from 22 work hours per ton of finished product to less

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[20]Jerzy Hausner, "The Future of Industry in Central and Eastern Europe: The Polish Industry," Institut Arbeit und Technik, Wissenschaftzentrum, Nordrhein-Westfalen, 1995, 10.

[21]Interview with Romuald Talarek, Vice President, Metallurgical Chamber of Industry and Commerce, Katowice, Poland, June 26, 1996.

than 5 work hours, a level more competitive with the 1.5 work hours per ton achieved at the most efficient mini-mills in Western Europe and Latin America.[22] To achieve these goals, the report recommended the concentration of production through the liquidation of nearly half the country's mills, and a reduction in total employment by over 50%. Production would not be cut proportionately to employment, since the report recommended aggregating production processes in larger plants. The total investment required for restructuring the sector was estimated at over $4.4 billion over ten years, including just $300 million for restructuring employment by providing job training and payments for job leavers.[23] It was expected that much of this funding would be secured through government guarantees for loans from international creditors such as the World Bank, the European Bank for Reconstruction and Development, and the European Iron and Steel Community, as well as from government resources and firms' earnings. Due to the lack of a coordinating institution to implement the plan, the social costs involved, limited government resources, and the lack of political will, the program has not been implemented.

After the victory of the former-communist Democratic Left Alliance and its coalition partner, the Polish Peasants' Party, in the national elections of September 1993, a new government under Prime Minister Pawlak established an Intervention Fund to provide additional assistance for enterprise restructuring. The Fund was capitalized by funds from the state budget as well as from a World Bank loan of $350 million over three years.[24] In March

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[22]Barbara Pytel, "The Polish Iron and Steel Industry: The Future of Industry in Central and Eastern Europe: Industry Study," Institut Arbeit und Technik, Wissenschaftzentrum, Nordrhein-Westfalen. 1995, 12.

[23]Pytel, 17.

[24]Hausner, 12.

March 1995, the Ministry of Industry and Commerce presented to the Government a proposal entitled "The International Competitiveness of Polish Industry: An Industrial Policy Program for the Years 1995-97," in which it recommended abandoning the previous sectoral approach and focused on specific regions. Current policy goals include export promotion, technical support (including assistance for research and development) and privatization, especially in regions with a high concentration of industry such as Katowice.

B. Restructuring by Individual Firms

In place of a coordinated restructuring program financed and implemented by the state, Polish steel mills have begun to restructure independently, in some cases with government help in the form of loan guarantees, waivers of tax arrears, or subsidized credit from the National and Voivodship Environmental Funds. One disadvantage of not having a centralized restructuring program is that some mills designated by the Canadian Consortium report for closure have been modernized at the expense of better mills, thus using up resources that may have been used more efficiently for restructuring the entire sector.[25] However, some investment programs have helped rationalize production at plants such as the Katowice Steelworks, which received a government guarantee for credit from international financial institutions for a strand casting line. In addition, the Baildon Steelworks , which specializes in ferroalloys and high quality steel, received a government guarantee for part of a domestic bank loan used to finance its new rolling mill.

The main thrust of Poland's *ad hoc* restructuring process has been the liquidation of

[25]Pytel, 14.

inefficient and heavily polluting processes for making steel, and their replacement by more modern forms of technology. As discussed above, four open hearth furnaces were liquidated in Katowice in 1991, and fifteen more between 1992-1994.[26] Completed liquidations of open hearth furnaces resulted in a reduction of productive capacity by 3.4 million tons as of 1995, or approximately 25% of the total production of raw steel.[27] In addition, the former Bobrek steelworks in Bytom was slated to close its blast furnace by 1997.

Technological Development

In addition to shutting down old, heavily polluting furnaces for making raw steel and pig iron, steel firms in Poland, and Katowice in particular, have modernized the process of casting liquid steel . The Canadian Consortium Report stated that by 2002, 95% of Poland's steel should be produced by continuous casting--a process that increases labor and capital productivity and lowers the energy intensity of production. Though the Consortium's recommendations were not officially implemented in a government led program, it appears that Poland may reach this goal due to restructuring under way or already complete at individual plants. As of mid-1996, approximately 60% of Polish steel was processed using continuous casting technology, most of it purchased from Austria or Germany. By the end of 1996, when a number of continuous casters come on line, some 90% of Polish steel will be

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[26]"Podstawowe Kierunki Dzialan w Zakresie Ochrony Powietrza w Zakladach Hutniczych na Lata 1992-95,." (Basic Directions for Action in the Sphere of Environmental Protection in Steel Enterprises in the Years 1992-95), Institute for Industrial Ecology, Katowice, Poland. June 1993, 6.

[27]Pytel, 18.

made using continuous casting at a total of seven plants.[28] Three of these steelworks are located in Katowice voivodship. They are the Baildon Steelworks, Huta Katowice (which will have a third line of continuous casting in operation by the end of 1997), and Huta Labedy.

Capital Stock and Investment

Investments in continuous casting technology and the liquidation of open hearth furnaces have significantly modernized the capital stock of the Polish steel industry. New investments are reflected in annual statistics that show that real investment in the Polish iron and steel industry increased after 1990 and then stabilized at a level higher than that of the mid to late 1980s. Investment levels in 1993 were higher in real terms than those of 1985. Consequently, the gross value of capital stock in Polish iron and steel plants has increased since 1991 (see Table 9). In 1993, total capital stock in the Polish iron and steel industry amounted to 7.9% of all industrial assets, a slight decrease from 1991, when iron and steel amounted to 8.3% of total industrial assets in Poland.[29]

[28]Interview, Dr. Franciszek Grosman, Minister's Plenipotentiary for Restructuring of the Iron and Steel Industry, Ministry of Industry and Trade, Katowice, Poland, June 27, 1996.

[29]Polish Statistical Yearbook 1994.

Table 9

Investment and the Value of Capital Stock in Polish Iron and Steel Industry
(in billion zlotys, 1990 prices)

	1985	1990	1991	1992	1993
Total Investment	1,282	2,531	--	1,906	1,326
Capital Stock	--	--	80,757	82,241	84,238

Source: Polish Statistical Yearbook 1994 and author's calculations.

C. Privatization of Steel Mills

As with restructuring, privatization of Poland's iron and steel works has proceeded on a case by case basis. Unlike other Central European countries such as the Czech Republic, which pursued a rapid privatization program for some steel companies based on the assumption that new owners were the best candidates to restructure firms, Poland has adopted an approach that favors restructuring prior to full privatization. The government did not draft a special program in which it integrated privatization and restructuring of the steel industry. Rather, Polish policy has been one of encouraging plants to pursue their own restructuring plans, with some government assistance, prior to privatization. Only one steelworks in Poland, Lucchini Warsaw, is fully privatized. Through a joint-venture agreement, the majority of the Warsaw steelworks was sold to an Italian steel concern, with approximately 45% held by the Polish side, primarily by the mill's former creditors.[30] Several Polish steel works are still entirely state-owned, including the 1st of May steelworks in Katowice, and are

[30]Interview with Romuald Talarek, Vice President of the Metallurgical Chamber of Industry and Commerce, June 26, 1996.

subject to control by the Ministry of Industry and Trade. The government has "commercialized" some 40% of the remaining Polish steelworks by converting them from state-owned enterprises into joint stock companies, the first stage in privatization. In some of the joint stock companies, the state has retained approximately 50-60% ownership, while selling the remainder to a variety of investors, including banks, individuals, trade organizations, workers and managers.

In addition to the prevailing case by case, partial privatization of Polish steelworks, approximately six to seven plants are participating in Poland's mass privatization program. The program, which was designed in 1992 but has only recently been implemented, is similar to that which was implemented in the Czech Republic beginning 1991. Poland's program allows individual citizens to receive shares in companies at virtually no cost. These shares are managed by fifteen National Investment Funds, run by consortia of international and domestic investment banks, which will take a lead role in managing the firms in which they have a large stake. Several steelworks located in Katowice will participate in the mass privatization program, including Huta Ferrum, Huta Zygmunt, Huta Zawiercie, and Huta Zabrze, all of which are currently joint stock companies.[31] The slow and rather *ad hoc* process of Polish privatization to date makes it difficult to assess what impact private ownership will have on the industry. In the meantime, even joint stock companies are largely still controlled by the state. In some cases, the state's ambivalence toward implementing a comprehensive program for privatization and restructuring of the iron and steel industry has stalled potential modernization of Katowice's steelworks by discouraging foreign investment

[31]Interview with Dr. Franciszek Grosman, Minister's Plenipotentiary for Restructuring of the Iron and Steel Industry, Ministry of Industry and Trade, Katowice, Poland, June 1996.

and increasing uncertainty over the steelworks' future.

D. A Case Study: Baildon Steelworks

Huta Baildon is not a typical Polish steel company due to its emphasis on high quality steel products rather than raw steel, and its advantage in the domestic market due to its possession of more modern forms of equipment than the average Polish steel mill. Baildon does, however, offer a useful example of a steel company that has made significant environmental investments since 1990 while remaining under state ownership. A brief description of Baildon's restructuring and environmental improvements is included in this study in order to provide insight into the processes of restructuring at individual firms in Katowice.

Huta Baildon was established in 1823 by Scottish engineer John Baildon, and is located within the city of Katowice. (Though the company was founded on the outskirts of town in the early 1800s, the city has since grown up around it). Baildon steelworks specializes in medium and high alloy steel. Its main products are cold rolled strips, steel wires, bars and rolls, as well as a variety of specialized products such as twist drills, magnets, dental implants and coated welding electrodes. Huta Baildon is state-owned, but will be converted into a joint stock company by 1997, at which time it may be partially purchased by management and divided into several companies. As part of an overall restructuring program, Baildon has scaled back its workforce. In 1990, the steelworks employed over 5,700 people. By 1995, total employment was reduced to 3,400, largely through voluntary

departures and early retirement programs.[32]

Huta Baildon is an example of a steelworks that has made significant environmental investments since 1990 to lower emissions of heavy metals. Its production activities are not as pollution intensive as those of other plants in the region since it does not produce raw steel, and therefore does not require use of an open hearth or blast furnace. Baildon's main activity is the creation of ferroalloys in its electric arc furnace, in which it melts steel scraps purchased on the domestic market. In 1978, Baildon's electric arc furnace was installed with dust extraction technology that operates in two stages to remove heavy metals and other dust released during the production process. In the first stage, dust is collected by a fan that forces emissions into cloth filters. Emissions that are not trapped during the first stage are collected in a waste gas hood and forced into a second series of filters. Dust collected by the filters is sold to cement plants for the manufacture of clinker bricks.[33] In order to comply with stricter standards for heavy metal emissions established in 1990, Baildon steelworks replaced the filters on its dust extractor. Though this did not represent the installation of new technology, it was quite costly for the firm. Baildon steelworks also built a modern sewage treatment plant to clean effluent of heavy metals and sludge from its strip plant. Investment in the plant, totalling approximately $2 million, was financed half from the steelworks earnings, and half from a low interest loan from the National Environmental Fund.

As part of its modernization program, Baildon also began installing a new billet caster manufactured by the Austrian firm Voest Alpine in 1993. The billet caster began operating in

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[32]Baildon Steelworks, Katowice, Poland.

[33]Interview, Iwona Goral, Department of Marketing, Baildon Steel Works Katowice, Poland, June 27, 1996.

early 1996.[34] The continuous casting equipment includes an intensive gas and dust exhaust system to remove emissions of heavy metals released during the casting process. Though Baildon steelworks has successfully modernized much of its production, while concurrently investing in environmental equipment to limit pollution, it has been able to achieve these changes with the help of subsidized financing from state environmental funds. In addition, it was fortunate to be in rather good financial condition compared to other steel mills in the country, many of which are deeply in debt.[35] Restructuring and environmental investment will probably not be possible at more troubled steelworks without at least some help from the state or from international financial institutions willing to provide credit at below market rates.

IV. Policy Options

Policy options for reducing heavy metal emissions from the iron and steel industry in Katowice must be considered within the context of two inter-related processes: privatization and restructuring of the steel industry as a whole, and environmental regulation. The processes of economic reform and firm-led restructuring, including investment in modern technology and pollution control devices, is expected to lead to improvements in environmental conditions. Parallel to the process of restructuring, and providing incentives that drive it, is environmental regulation of heavy metals by the voivodship organs and the Ministry of Environment. These bodies also channel environmental investment through the

[34]Ryszard Brzozowicz et al, "Continuous Casting Machine for Special Steels in Huta Baildon," Unpublished mimeo, Katowice, April 1996.

[35]Pytel.

national, regional and local environmental funds. Getting to the root of heavy metal pollution in Poland will be difficult without improving the general processes of industrial restructuring of iron and steelworks and strengthening the process of environmental regulation.

A. Criteria for Assessment of Policy Options

Policy options for reducing heavy metal emissions from the iron and steel industry in Katowice should be evaluated according to multiple criteria that weigh the varied economic and social costs involved against the varied benefits provided by each policy. Seven criteria are employed in this report for evaluating current and future policy options. First, a consideration must be given to the social costs involved in any policy, due to the large degree of state ownership in the steel industry, and the pressure that the state faces to make its policies publicly acceptable. In the case of restructuring the highly over-employed iron and steel sector, the most significant social cost to consider is unemployment. Second, the economic costs to the firm and/or the government must be considered, whether the policy is the installation of pollution control equipment, or the enforcement of new regulations. Third, the environmental and health benefits to be gained by the policy in reductions of heavy metal emissions must be taken into account. Fourth, the timeliness or rapidity of reducing these emissions may influence the acceptability of a policy. Fifth, political feasibility at the national, regional and local government levels is crucial for a policy's success, especially in the politically volatile environment of Poland's transition to democracy and a market economy. Sixth, certain policies may generate positive economic externalities for domestic

industry, such as the provision of subsidies for environmental investment. These externalities should be taken into consideration when evaluating a policy. Finally, the ease of implementation from the government's point of view is a necessary criteria, especially given limited resources available to environmental and other public authorities. Employing these multiple criteria should facilitate an objective assessment of different policy options. Any assessment, however, is complicated by the fact that many of the policies are not directed specifically at heavy metal pollution, but at industrial restructuring or environmental protection in general, and that many of the costs and benefits are difficult to quantify.

B. Evaluation of Actual and Potential Policies

This section assesses actual, proposed and future policy options to lower heavy metal pollution from the iron and steel industry in Katowice using the criteria described above. Policies assessed below can be usefully divided into three categories: modernization strategies for restructuring production; policy instruments used by the government; and financing options available to the government and firms for environmental investment.

MODERNIZATION STRATEGIES

1. Government-led Restructuring of the iron and steel industry has been proposed by the Polish government but not yet implemented. Such a policy would require direct government subsidies for modernizing steel production technology, government-led liquidation of excess capacity or of highly polluting mills, and subsidies for the installation of

emission controlling devices. This policy involves extremely high financial costs to the government, which could negatively impact the country's fiscal balance, increase Poland's foreign debt, and perhaps distort the domestic steel market by prolonging the life of inefficient firms. Though environmental benefits in terms of reduced heavy metal emissions would be high, and social dislocation and unemployment low, economic costs and political realities make this policy difficult to implement.

2. **Firm-led Restructuring** has prevailed among steel firms in Katowice in the absence of a centralized state restructuring policy. This laissez-faire policy on the part of the government has involved limited use of indirect subsidies to partially finance investments by steel firms for modernization and environmental improvements. Indirect subsidies include government loan guarantees, subsidized credit from the national and regional environmental funds, and in some cases a waiver of tax arrears. The remainder of funds for investment are financed by the steelworks from retained earnings and private sector credit. This policy has helped reduce economic costs to government while slowing the restructuring process enough to prevent large scale lay-offs. Gradual improvements in heavy metal emissions reductions will be increasingly realized as new technology comes on line; meanwhile, the *ad hoc* policy may stall further restructuring by slowing the privatization process and thus discouraging foreign and domestic investment in the industry. In addition, some highly inefficient, older firms may make investments that might have been better spent modernizing other facilities. This policy's main benefits are its low cost to the government, ease of implementation, and political feasibility.

POLICY INSTRUMENTS

1. **Environmental Monitoring and Enforcement** of standards for heavy metal emissions has been pursued by departments of environmental protection at the national and voivodship level. Standards for heavy metal emissions and other pollutants were made stricter in 1990. Fees and fines are charged to polluters to discourage emissions and to help capitalize environmental funds. Monitoring and enforcement is for the government a relatively low cost, politically acceptable policy for lowering heavy metal emissions compared to subsidizing large investment projects, though its environmental benefits may not be immediately apparent, and their effect is not as direct as the installation of pollution control equipment. Enforcement of environmental regulations, however, will encourage firms to invest in pollution control equipment. Implementation of effective monitoring and fee collection systems is challenging for voivodships with limited resources and capacity and with many companies under their jurisdiction. The state environmental agencies may engage in negotiations with firms regarding the most appropriate means with which to comply with regulations. The government's position in such negotiations could be strengthened in some cases with commitments for financial support to industry.

2. **Strengthening of Environmental Regulations** of heavy metals beyond current levels is a policy option available to the voivodship and national environmental authorities. The desire to harmonize environmental standards with those of the European Union may provide the impetus to raise standards in the case of some pollutants. This option would require steelworks to lower emissions of heavy metals, either by lowering production,

modernizing plants or installing pollution control equipment. Raising standards for heavy metal emissions poses very few costs on government in general, but requires firms to make significant investments that could threaten one source of competitiveness for the industry.

3. Technology and Process-Related Regulations could be incorporated to enhance existing emissions standards. Regulations on best available technology use, the prohibition of certain highly polluting production processes, and controls on inputs could help instigate increased intra-sectoral change that lowers pollution. Such regulations formed an integral part of successful efforts to reduce heavy metal emissions in the Ruhr area. Technology and process-related regulations would likely be most effective and less costly if implemented through constructive engagement and cooperation between government agencies and industry in the form of institutionalized negotiations and agreements.

4. Further Removal of Energy Subsidies could compromise the competitiveness of the Polish steel industry abroad, but it would go far in terms of limiting excess energy use and resulting heavy metal emissions. As energy combustion is the largest source of heavy metal emissions in the steel making process, policy instruments should be targeted in this area. Government efforts to raise energy prices, however, will likely encounter opposition from industry.

5. Tradeable Emissions Permits are a sophisticated means for regulating pollution levels. Environmental authorities issue permits allowing each firm a certain level of pollution. The total number of permits corresponds to the concentration of pollutants

permitted in the air quality standards. Firms are able to trade permits based on their desired levels of pollution. Permit schemes have been used in the United States to control emissions of SO2 and to help minimize the cost of compliance for firms. Permits allow firms with the lowest abatement costs to cut their pollution levels, and then sell their excess pollution permits to less efficient firms. This process lowers the costs of investment for industry as a whole, while achieving the required emission standards. In addition, permit schemes provide incentives for innovation in the field of pollution control technology. The price of permits is set by the market, and is thus automatically indexed to inflation. Fees and fines, by contrast, are currently not indexed to inflation in Poland. Inflationary effects are important to consider in Poland's transitional economy in which annual inflation averages approximately 20%. Further, permits provide opportunities for non-polluters, such as environmental groups, to buy up permits and thereby lower allowable pollution levels. The disadvantages of permit schemes are that they are complicated to implement, and are slower to produce results compared to the immediate installation of pollution control equipment. The economic savings to government and industry may, however, fully compensate for these drawbacks.

FINANCING OPTIONS

1. **Environmental Fees and Fines** for pollution are currently charged to firms and used to capitalize Poland's national, regional and local environmental funds. These funds are channelled to firms and municipalities in the form of grants and loans to finance environmental-related investments.

2. **Direct Government Subsidies** have been proposed but not yet applied in Poland to reduce heavy metal pollution at firms. Such subsidies would be financed directly from the government budget and could lead to a worsening of the state's fiscal position. Indirect subsidies are available through the waiver of tax arrears and loan guarantees (see below).

3. **Government Loan Guarantees** for credit from domestic banks and international financial institutions is a low cost option used by the government in limited cases to help finance pollution control equipment or restructuring of steelworks. The use of guarantees could be expanded, and administered by the national or regional environmental funds or by the government itself. To lower risk exposure to the government, as well as moral hazard on the part of participating banks, the government should provide only partial loan guarantees, with the remainder of risk for the loan assumed by the participating financial institutions.

4. **Debt-for-Environment Swaps** have not yet been applied specifically to the problem of heavy metal pollution in Poland, though such swaps were concluded in 1991 to capitalize Poland's Ecofund. They would be an effective means for financing environmental investment to lower heavy metal emissions. Funds provided by a debt-for-environment swap could be channelled through national or regional environmental funds. Poland's large outstanding official and private sector foreign debt, and its past experience with debt for environment swaps, make this option attractive. A swap poses almost no cost to the government beyond current obligations, and is not politically sensitive for the government. Creditors have an incentive to participate in swaps if the probability of the loan being fully repaid is low. In this case, the debt can be purchased at a discount by the government,

environmental organizations, or by other bodies interested in lowering emissions. Implementation of the swap, however, is complicated by international negotiations with creditors and by the need to find a party interested in purchasing the debt at a discount (in the case of private sector creditors).[36]

5. Input Taxes could be levied on substances with a high heavy metal content, such as coal, which are used in the steel making process. Such taxes would provide an economic disincentive to use polluting inputs, and would help raise revenue for environmental investment. Such taxes were employed successfully in the Ruhr area.

6. Private Credit Markets are a financing option currently being used by iron and steelworks in Poland for environmental investment. The use of credit for environmental investment from private markets poses no cost to the government, though steel firms bear the full cost of interest rates which are higher than those for credit from the state environmental funds. If private credit is available for projects, it should be used. Environmental projects for reducing heavy metal emissions are bankable in private credit markets when they represent "win-win" options for which a firm will be financially compensated by increased or more efficient production, greater revenues, etc. Other projects, however, may require partial or full government guarantees, or interest rate subsidies.

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[36]For more on Debt-for- Environment Swaps concluded by Poland, see Milena Novy, "International Efforts to Combat Heavy Metal Pollution in the Black Triangle and Katowice Regions," Paper for IIASA Workshop, April 1996.

7. **Tax Write-Offs** for a firm making environmental investments is another potential financing option. Such write-offs would allow firms to count increased depreciation in a single year against their taxes, based on the amount invested in pollution control equipment. Such write-offs could also be used to help finance investment in cleaner production processes such as continuous casting technology.

V. Conclusion

The iron and steel industry in Katowice has played, and will continue to play, a crucial role in the district and national government's efforts to strengthen the region's economy and improve its environmental conditions. Steel accounts for a disproportionate amount of total employment and industrial production in Katowice compared to the country as a whole, and the iron and steel industry is also a major contributor to heavy metal pollution in Katowice. Lead and zinc emissions from the iron and steel industry in the region rank second only to energy production.

Industrial restructuring and environmental regulation will be crucial to lowering emissions of heavy metals in Katowice. Government policy in both of these areas could have a decisive impact on emissions reductions. In the sphere of industrial restructuring, the Polish government should set clear timelines for completing privatization of the industry. This will encourage efficiency at the firms in the meantime, as managers realize that their current actions could impact their chances for future employment, while also drawing foreign and domestic private investment for needed modernization. If the government decides to

further delay the privatization process, it should lay out a clear industrial policy for the sector, including financial assistance for environmental investments. Options for financing such investments have been described in the policy section above. Continued state-ownership in the industry has the additional impact of diminishing the effectiveness of environmental regulation, the enforcement of standards, and the collection of pollution fees and fines.

Given the government's limited resources and its current distaste for a comprehensive industrial policy due to years of communist planning, the present policy of encouraging firms to seek private sector financing for environmental investments, buoyed by limited government assistance, is likely to prevail. The government can best support the process of industrial restructuring and the lowering of heavy metal emissions by improving its capacity for environmental regulation. Following successful attempts at environmental clean-up of heavy metals and other pollutants in the Ruhr area and elsewhere, the Polish government may benefit by expanding environmental standards to include technology and process related regulations. Additionally, public involvement should be encouraged as a means to monitor industry and ensure that policies are directed effectively to issues of local priority.

Bibliography

Blazejczak, Juergen. "Workshop Report." Rhine/Black Triangle Policy Comparison Workshop. International Institute for Applied Systems Analysis. Laxenburg, Austria, 1995.

Brzozowicz, Ryszard et al. "Continuous Casting Machine for Special Steels in Huta Baildon." Unpublished mimeo. Katowice. April 1996.

Cimander, Bernard and Jan Szeliga. "Air Pollution in Katowice Province." *Aura*. November, 1992.

De Bruyn, Sander and Simone Schucht. "Industrial Transformation and Development of Heavy Metal Emissions in Northrhine-Westfalia: Decomposition and Material Flow Analysis." *Working Paper* WP-96-8. International Institute for Applied Systems Analysis. Laxenburg, Austria. 1996.

"Dziennik Ustaw Rzeczpospolitej Polskiej," No. 15. Warsaw. 14 March 1990.

Frydman, Roman, Andrzej Rapaczynski, and John S. Earle. *The Privatization Process in Central Europe*. Central European University Press.

Hausner, Jerzy. "The Future of Industry in Central and Eastern Europe: The Polish Industry." Institut Arbeit und Technik. Wissenschaftzentrum, Nordrhein-Westfalen. 1995.

Katowice Voivodship Statistical Yearbook. Katowice, Poland. 1992, 1994, 1995.

Kucharski Jr., Rafal. "Legal Aspects of Air Pollution Abatement in Poland." Unpublished memorandum. Institute for Ecology of Industrial Areas. Katowice, Poland. October 1995.

Lipowczan, Karol. "The iron and steel industry in Poland." *Encyclopedia of Polish Industry*. 1995.

Metal Bulletin Monthly East European/CIS Supplement. "A Throughly [sic] Modern Polish Steel Industry?" June 1996.

"Podstawowe Kierunki Dzialan w Zakresie Ochrony Powietrza w Zakladach Hutniczych na Lata 1992-95." (Basic Directions for Action in the Sphere of Environmental Protection in Steel Enterprises) Institute for Industrial Ecology. Katowice, Poland. June 1993.

Poland Case Studies. Discussion Paper Series, No.2. CIS Middle Europe Centre, London Business School. October 1993.

"Polish Privatization, At Last, at Last." Business Central Europe, July/August 1995.

Polish Statistical Yearbook. Central Statistical Office (GUS). Poland. 1994.

Pytel, Barbara. "The Polish Iron and Steel Industry: The Future of Industry in Central and Eastern Europe: Industry Study." Institut Arbeit und Technik. Wissenschaftzentrum, Nordrhein-Westfalen. 1995.

Schaeffer, Mark E. *Polish Economic Transformation: From Recession to Recovery the Challenges Ahead.* London School of Economics. Discussion Paper Series, No.5. CIS Middle Europe Centre. London Business School. October 1993.

"Restrukturyzacja przemyslu stalowego."(Restructuring of the Steel Industry) Polish American Post-Diploma Studies. *Hutnik.* 1995.

Zawiejska, Anna. "The Guidelines of Air Protection Policy in the Katowice Voivodship." Department of Ecology. Voivodship Office, Katowice, Poland. October, 1995.

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