GLOBAL ENVIRONMENT FACILITY

Poland

Coal-to-Gas Conversion Project

Project Document
October 1994

THE WORLD BANK

GEF Documentation

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CURRENCY EQUIVALENTS

US$ 1.45522 = SDR 1.00 (Special Drawing Rights, As of July 31, 1994)
US$ 1.00 = NKr 7.425 (Norwegian Krone)
Polish Currency unit : Zloty (Zl)

	1989	1990	1991	1992	1993	March 1994
US$1 = Zloty	4,000	9,500	11,100	13,630	17,000	22,000

WEIGHTS AND MEASURES

(Metric and International Systems)

°C	:	Degree Celsius
Gcal	:	Gigacalorie (one million kilocalories)
GJ	:	Gigajoule (0.034 tons of coal equivalent or 10^9 joule)
kcal	:	Kilocalorie (4187 Joule)
kWh	:	Kilowatthour
kWe	:	Kilowatt electric
kWt	:	Kilowatt thermal (860 kcal/h)
Mt	:	Million tons
Mtce	:	Million tons of coal equivalent (0.65 Mtoe, or 29.3 PJ)
Mtoe	:	Million tons of oil equivalent (1.54 Mtce, or 45.1 PJ)
MWe	:	Megawatt electric (1,000 kilowatt)
MWt	:	Megawatt thermal (0.86 Gcal/h)
Nm^3	:	Normal Cubic Meter
PJ	:	Petajoule (34,129 tons of coal equivalent or 10^{15} joule)
TJ	:	Terajoule (34.1 tons of coal equivalent or 10^{12} joule)
toe	:	Ton of oil equivalent (42.7 GJ)
TWh	:	Terawatthour (10^{12} Wh)

CALORIFIC VALUES

Coal	:	24.3 GJ per ton (0.8% sulfur; 10% ash)
Coke	:	30.0 GJ per ton (0.4% sulfur; 10% ash)
Light Fuel Oil	:	41.0 GJ per ton (1% sulfur)
Natural Gas	:	34.3 MJ per Nm^3

GLOBAL EMISSION RATES

Coal/Coke	:	92 kg of CO_2 per GJ input
Light Fuel Oil	:	77 kg of CO_2 per GJ input
Natural Gas	:	53 kg of CO_2 per GJ input

RELATIVE GLOBAL WARMING POTENTIAL FACTORS

(on mass basis and for a 100-year time horizon)

Methane (CH_4) : 21 times the global warming of CO_2

ABBREVIATIONS AND ACRONYMS

BOS	:	Bank Ochrony Srodowiska SA (Bank for Environmental Protection)
CHP	:	Combined Heat and Power Plant
CO_2	:	Carbon Dioxide
CO	:	Carbon Monoxide
DHE	:	District Heating Enterprise
EcoFund	:	Polish Debt-to-Environment Swap
EE Fund	:	Energy Efficiency and Conservation Fund (GEF Project Sub-component)
EIA	:	Environmental Impact Assessment
EPC	:	Engineer, Procure and Construct
ERT	:	Emission Reduction Technology
GDP	:	Gross Domestic Product
GEF	:	Global Environmental Facility
GET	:	Global Environmental Trust Fund
GHG	:	Greenhouse Gases
HOB	:	Heat-Only Boiler
FCCC	:	Framework Convention on Climate Change
IPCC	:	Intergovernmental Panel on Climate Change
IRR	:	Internal Rate of Return
Jana Street	:	Location of Pilot Project - Boilerhouse belonging to MPEC Krakow
KSCH	:	Krakow Senior Citizens Home
LPAP	:	Local Policy Advisory Panel
MoEPNRF	:	Ministry of Environmental Protection, Natural Resources and Forestry
MPEC Krakow	:	Municipal District Heating Enterprise of Krakow
National Fund	:	National Fund for Environmental Protection and Water Management
NOx	:	Nitrogen Oxides
OECD	:	Organization for Economic Cooperation and Development
PPA	:	Project Preparation Advance
PUK	:	Polytechnic University of Krakow
SDR	:	Special Drawing Right
SIEP	:	State Inspectorate for Environmental Protection
SO_2	:	Sulfur Dioxide
STAP	:	Scientific and Technical Advisory Panel
TAG	:	Technical Advisory Group
UNCED	:	United Nations Conference on Environment and Development
Warszawska Street	:	Location of Pilot Project - Boilerhouse belonging to PUK

POLAND - FISCAL YEAR

January 1 - December 31

Part I: Project Summary

POLAND - COAL-TO-GAS CONVERSION PROJECT

Grant and Project Summary

Grantee:	Global Environmental Facility
Country:	Republic of Poland
Project Name:	Coal-to-Gas Conversion Project
Amount:	SDR17.2 million (US$25 million equivalent)
Terms:	Grant from the Global Environmental Trust Fund
Cofinancier:	Kingdom of Norway
Additional Cofinancing Grant Amount:	NKr7.425 million (US$1.0 million equivalent)
Grant Recipient:	Ministry of Environmental Protection, Natural Resources and Forestry
Beneficiaries:	Public and private owners of non-industrial boilers, and new residential building owners
Implementing Agency:	Bank Ochrony Srodowiska SA
Associated IBRD Project:	Environment Management Project (Loan 3190-POL, approved in April 1990)
Project Objectives:	The project's objectives are: (a) to stimulate self-replicable technological and institutional changes that would promote coal-to-gas conversion in small and medium-size boilers and induce more energy-efficient practices in the architectural design and operation of new residential buildings; and (b) to demonstrate interfuel substitution and improve the overall energy efficiency throughout the heat supply chain, as a means of reducing carbon dioxide emissions.

This report is based on the findings of an appraisal mission that visited Poland on May/June 1993, and was prepared by Messrs. Rachid Benmessaoud (Task Manager), François Chapelle (Research Assistant), and consultants Joseph Deringer (Architect Engineer), Harold Falkenberry (Boiler Engineer) and Bernd Kalkum (District Heating Engineer). The appraisal mission included Messrs. Rolf Selrod (Environment Economist) and Erik Sorensen (Energy Economist) representing the Government of the Kingdom of Norway. The report was issued by the Energy and Environment Division (Bernard Montfort, Chief) of the Central Europe Department (Kemal Derviş, Director).

Project Description: The project comprises the following components: (a) investments in the conversion of small and medium-size coal-fired boiler houses to gas-firing and in the installation of energy-efficient equipment in new residential buildings; and (b) technical assistance to project participants, including project management, environmental monitoring, and nationwide marketing.

Financing Plan:

Financing Sources	US$ Million Equivalent		
	Local	Foreign	Total
GET Fund a/	2.15	23.85	26.00
Local Sources	22.32		22.32
TOTAL	24.47	23.85	48.32

a/ Includes cofinancing grant of US$1.0 million equivalent from the Kingdom of Norway.

Benefits: Global benefits include a 65% reduction in CO_2 emissions by converting small coal-fired boilers to gas-firing and a 28% reduction in CO_2 emissions by increasing the energy efficiency in new residential buildings. Local benefits include virtual elimination of sulfur dioxide and particulates and significant reduction in nitrogen oxide emitted by the converted boilers.

Internal Rate of Return: 25% for the coal-to-gas conversion component, with a cost-effectiveness of US$37-67 per ton of CO_2 reduced.
11% for the residential energy efficiency component, with a cost-effectiveness of US$185 per ton of CO_2 reduced.

Map No.: IBRD 25145

POLAND

COAL-TO-GAS CONVERSION PROJECT

Background

1. **Country and Energy Sector.** Poland had a per capita 1992 Gross Domestic Product (GDP) of about US$2,200 and is eligible for GEF financing. The energy sector, which is one of the largest in the Polish economy, has developed without regard to economy, efficiency and the environment. Energy intensity, although declining, is estimated to be about 1.6 times as high per unit of GDP estimated on a purchasing power of currency basis as in European countries in the Organization for Economic Cooperation and Development (OECD) and five times as high per unit of GDP estimated on exchange rate basis, although per capita energy consumption is at about 60% of the OECD level. Pollution problems related to the energy sector are significant.

2. **Factors Influencing the Conversion from Coal to Gas.** The factors that influence conversion from coal to gas, as discussed below, are fuel shares, boiler size, energy pricing and air pollution standards.

3. <u>Fuel Shares</u>. Poland's energy market is dominated by domestically produced coal. In 1992, hard coal and lignite together supplied about 76 percent of Poland's primary energy consumption in 1992. This rate is well above the share justified by the structure of Poland's economy (which is strongly skewed toward heavy, energy-inefficient industry). The primary reasons for the high share of hard coal and lignite are the past policy of heavily subsidized prices of coal, secure in-country availability of coal as the primary energy source, and a disregard for the severe environmental pollution caused by current coal combustion. Comparisons with West European countries indicate that coal's share of primary energy consumption in Poland should be reduced to between 25 and 45 percent, depending on the economic and industrial restructuring and on the development of the power sector. This shift would imply an increase in the share of gas and oil from 23 percent in 1991 (one of the lowest in continental Europe) to between 53 and 73 percent.

4. <u>Boiler Size</u>. Coal is normally preferable to gas (or oil) only in large boilers (more than 50 Megawatt-thermal [MWt]) or medium-size boilers (5-50 MWt), in which economies of scale allow the price differential between coal and gas to amortize the additional costs of handling the coal and of the emission control equipment. However, because, until recently, coal prices in Poland were more heavily subsidized than gas prices, coal has also been the preferred fuel for smaller boilers (less than 5 MWt) to a much greater extent than is the case in other countries.

5. <u>Energy Pricing</u>. Since 1990, Poland has made major progress in reforming its energy prices. Although further significant adjustments are necessary for prices to reach economic levels, the impact is beginning to be felt in the areas of energy efficiency and conservation and reduction of pollution. The main elements of the reform include liberalization of coal prices, increases in the energy prices for industry toward economic levels, and gradual increases in the

energy prices for households first to the level paid by industrial consumers and then to levels reflecting economic costs. At present, network fuel prices, although still being controlled, are on average about 60 percent of their estimated economic levels, with the percentage for individual fuels ranging from 50-100 percent, depending on the tariff categories. For example, the price of gas for non-residential users is now about 100 percent of the economic level. The prices of coal, which are virtually set by the free market, have almost reached import parity levels. Elements of energy pricing reform were supported by the Bank's Structural Adjustment Loan (SAL 3247-POL), the energy Sector Adjustment Loan (SECAL 3377-POL) and the Energy Resource Development Loan (Loan 3215-POL).

6. Higher coal prices would lead to price-driven conversions from coal to gas, which would result in the reduction of emissions of carbon dioxide (CO_2) and other air pollutants such as sulfur dioxide (SO_2), nitrogen oxides and particulates. Such a conversion would start with small boilers and would consist mainly of replacing coal-fired boilers with gas-fired boilers for units that need to be rehabilitated or retired (in district heating) or replaced for process reasons (in industry). In addition, higher fuel prices would also induce improvements in energy efficiency, a change that will further reduce the emissions of CO_2 and other air pollutants. However, pricing coal at an economic level will not by itself provide a sufficient incentive for conversion to gas. The main reason is that the environmental charges for local pollutants are low compared to the true damage to the environment.

7. Air Pollution Standards. The Bank's Environment Management Loan (Loan 3190-POL) is financing technical assistance to the Ministry of Environmental Protection, Natural Resources and Forestry (MoE) and to local environmental administrations, the beneficiaries, to improve, inter alia, the management of air quality in Poland (see para. 15). The Government has introduced new emission standards that are to become effective January 1, 1998. These standards are in line with the standards used in countries in the European Union, but the timing of the introduction of the SO_2 standard for large power plants is unrealistic. However, the existing as well as the proposed ambient standards are much stricter than comparable standards in Western countries and it is unrealistic to expect that these standards will be enforced in the near future. The Bank is discussing with the Government the need to set realistic and enforceable emission and ambient standards that are driven by the need to achieve a healthy ambient air quality. In setting ambient standards, cost-benefit analyses of the damage caused by different pollution levels and the costs of reducing emissions would need to be carried out. Emission standards should then be designed to ensure that the desired ambient standards are met.

8. A further issue to be addressed with the Government is that monitoring and enforcement is currently tighter for larger sources of pollution than for smaller ones. Effective enforcement of the new standards for small and medium-size boilers will need to be phased in during the next few years. In countries with similar emission standards, in general the least-cost option for getting small boilers to meet the standards is to switch to gas or oil. Often, it is the only option. As Poland progressively tightens enforcement of its emission standards,

and as it gradually increases the environmental charges to levels reflecting the true costs of environmental damage, the price-driven shift from coal to gas in small boilers will be accelerated. The rate of change from coal to gas is, however, likely to be much lower among the large number of medium-size boilers because economies of scale could justify the additional costs of using clean coal technologies and of emission control equipment.

9. **Technology Options**. Substantial reductions in CO_2 emissions can be achieved by converting to gas and increasing the efficiency of heat supply, distribution, transfer and end-user systems. By itself and for the same level of efficiency of fuel conversion, simply converting from coal to gas, without improving end-use efficiency, would lead to at least a 43 percent reduction in corresponding emissions of CO_2.

10. On the Supply Side. For small and medium-size coal-fired boilers in Poland, the efficiency of fuel conversion is typically low, in the 50-65 percent range. Generally the older the boiler, the lower the efficiency is. New replacement coal-fired boilers would have efficiencies of about 78 percent, which could reduce CO_2 emissions by 17-36 percent. Higher efficiencies can be achieved by replacing old coal-fired boilers with either new conventional gas-fired non-condensing boilers (84 percent efficiency), high-efficiency gas-fired condensing boilers (95 percent efficiency), or a single larger unit that would cogenerate both heat and electricity (78 percent overall efficiency). Compared with old existing boilers, the higher efficiency boilers (condensing technology) would reduce CO_2 emissions by 62-70 percent. With the cogeneration option, the overall efficiency of fuel conversion would remain about the same as for a new coal-fired boiler (78 percent); and the electric power produced in cogeneration would replace the power now being generated from coal in the national power system at only 30-34 percent efficiency. Compared with old existing boilers, the cogeneration technology option would reduce CO_2 emissions by 65-69 percent on a national basis. Cogeneration (combined heat and power production) is now common in Poland with large boilers. Recent technology developments with smaller, packaged, gas-fired cogeneration units, utilizing either reciprocating engines or gas turbines, now make these an attractive technology option for small and medium-size boilers as well.

11. On the Heat Distribution and Transfer Systems and on the Energy User Side. Further reduction in CO_2 emissions can be achieved by improving the energy efficiency of the heat distribution and transfer systems associated with the converted boilers and of the end-use facilities served by these boilers. Improvements in energy efficiency involve: (i) insulation of the heat network distribution and building piping systems; (ii) installation of automation, control and metering equipment at the heat transfer substations; (iii) installation of thermostatic control valves; and (iv) enhancing energy conservation awareness among building users and occupants. While efficiency improvements are not "coal-to-gas technology" options, such improvements become an integral part of any systems approach to boiler conversion. A primary focus on the easy-to-capture efficiency improvements in the heat distribution and transfer systems and in the end-use facilities would alone produce an estimated reduction in heat demand of about 10-18 percent. Further improvements in the

efficiency of building equipment, controls and operations could reduce heat demand by 20-30 percent, or more, and do so on a cost-effective basis from a national perspective. In this context, the coal-to-gas conversion project can be viewed as part of a larger program toward improved energy use, lower energy costs, and an overall reduction in CO_2 emissions.

12. **Availability of Gas Supply**. Poland's domestic production of natural gas in 1992 was 4.0 billion cubic meters (m^3), down from 5.4 billion m^3 in 1989. Imports of natural gas from Russia have remained flat, at about 6.7 billion m^3, and are not expected to increase significantly before 1995. Since 1990, Poland's economic reforms and industrial restructuring have led to a decline in the demand for gas by several major industrial consumers, and gas consumption by industry fell from 7.0 billion m^3 in 1990 to 5.7 billion m^3 in 1992. In response, Poland decided to maintain its contracted imports from Russia and to vary its domestic production according to the seasonal variations in gas demand. Additional demand for gas over the next five years will be met largely by: (i) restoring domestic gas production to its former levels; and (ii) storing gas seasonally to improve the average annual utilization of Poland's gas fields.

13. Within the framework of this GEF project, there would be no obstacles in supplying the estimated volumes of about 22 million m^3 per year. The supply of gas could, however, be limited in the peak period in the winter to meet the seasonal variations in the demand for gas either in large district heating boilers or in combined heat and power (CHP) plants. Such limitations result from the lack of seasonal flexibility in imports from Russia and a limited storage capacity. The magnitude of the limitations will also depend on load characteristics, geographical location and timing of the phase-in of any new demand for gas. To mitigate the impact of load variations, interruptible contracts are used for large gas consumers. In such cases, light fuel oil is used as the back-up fuel.

14. **Gas Distribution Network**. Poland's gas network has a limited capacity to serve large numbers of medium-size industrial consumers and to meet the incremental demand of households (see para. 12). The Bank's Energy Resource Development Loan is financing, inter alia, a strengthening of the gas transmission and distribution systems, mainly in existing service areas.

Associated IBRD Project

15. The proposed GEF Coal-to-Gas Conversion Project was approved by the GEF Participants in December 1991. It was initially proposed to be associated with the Poland - Heat Supply Restructuring and Conservation Project (Loans 3377/83-POL) approved in June 1991. However, because of the institutional and legal arrangements under the Heat Supply Project, which involve local rather than national concerns, the proposed GEF Coal-to-Gas Conversion Project would be more appropriately associated with the Poland - Environment Management Project (Loan 3190-POL) approved in April 1990. The Loan Agreement for the Poland - Environment Management Project was amended to incorporate the GEF component.

Project Objectives

16. The GEF assistance under this project would focus on those coal-fired boilers for which the conversion to gas is not financially attractive to the owners. The project has several objectives: (a) it would demonstrate interfuel substitution and technological innovation to improve overall energy efficiency throughout the heat supply chain as a means of reducing CO_2 emissions. The heat supply chain includes the heat supply, distribution and transfer systems, the end-use equipment and user behavior; (b) the project would build up the local institutional capability to make judgements during project analysis about capturing global externalities, such as CO_2 emission abatement; and (c) it would establish the organizational structure for implementing already selected pilot projects and replicating the GEF concept with other investment projects yet to be identified nationwide and to be funded under this project.

Project Description and Costs

17. The Government of Poland is first giving priority to national and regional environmental problems. Because of its participation in the Intergovernmental Panel on Climate Change, the Government of Poland is also determined to reduce greenhouse gases, principally CO_2 and methane. This strategy will become binding once Poland ratifies the Framework Convention on Climate Change (FCCC). Continued funding for Poland under the GEF - Second Phase may be dependent upon Poland's ratification of the Convention. Some estimates put Poland as the world's eighth largest producer of CO_2. The source is mainly the combustion of coal. Among the least-cost options for reducing CO_2 emissions in Poland is to encourage a more rapid transition from coal- to gas-firing in small and medium-size boilers. Supporting this transition through GEF resources would capture substantial global benefits by extending the size range of boilers that can be converted and by introducing more efficient technologies.

18. GEF funds would be used to: (a) encourage coal-to-gas conversions in small and medium-size boilers, whose owners could not achieve acceptable financial rates of return without concessional financing but who could demonstrate substantial energy efficiency improvements at the same time; and (b) quickly and strongly influence future investments to the benefit of global environmental objectives through pilot investments in residential buildings that integrate improvements in energy supply, distribution, transfer and end-user efficiency. These steps would significantly reduce CO_2 emissions from the residential sector in Poland.

19. **Project Scope of Work.** The project would move quickly to implement two identified pilot projects, provide technical assistance for the project and finance follow-on investments yet to be identified. The sites for the two pilot projects are located in Krakow. Each site represents a typical unit size of boilers found in Poland. The conversion technologies selected for the pilot projects involve one condensing boiler technology and one gas-turbine cogeneration system. For the follow-on individual projects, conversion technologies will be evaluated and selected on a case-by-case basis. The project is expected to include: (a) high-efficiency gas-fired boilers, involving either

condensing or non-condensing technologies; and (b) gas-fired cogeneration systems, involving either reciprocating engine or gas turbine technologies.

20. The project scope of work and overall cost estimates were determined on the basis of the technology mix selected for the Krakow pilot projects. The project would consist of two components:

(a) An investment component (US$44.79 million), to support: (i) the conversion to gas-firing of about 44 coal-fired boiler houses (US$43.86 million, excluding the costs of project engineering and management services, see para. 20.(b)); and (ii) the installation of energy-efficiency equipment in new residential buildings (US$0.93 million). ***For the coal-to-gas conversion subcomponent***, the conversion technology selected could include a possible technology mix of 6 small, packaged, gas-fired cogeneration schemes (estimated at US$4.85 million each) and 38 high-efficiency condensing boilers (estimated at US$388,500 each). The final mix of conversion technologies would depend on the Polish priorities. The final mix would affect the number of individual projects accomplished because of the potentially large differences in project costs. Each individual project design would include a number of elements: (i) supplementary energy efficiency improvements in the heat distribution and transfer systems associated with the converted boilers and in the existing buildings supplied by these boilers; (ii) connection to main network fuels; and (iii) integrated monitoring system to assess project performance and environmental benefits. ***For the energy efficiency subcomponent***, 670 to 800 new residential building units would be equipped with: (i) increased insulation for walls, ceilings and windows; (ii) improved efficiency, automation and control of heat installation; and (iii) energy-efficient electric appliances. In addition, residential tenants would receive information on energy conservation and efficient consumption behavior; and

(b) a technical assistance component (US$3.53 million), covering: (i) project organization and administration; (ii) project engineering and management services; (iii) consultancy services for project appraisal, supervision of implementation, and a nationwide marketing of the GEF project concept; (iv) training; and (v) monitoring systems.

Project Cost Estimates

21. Based on the technology mix assumed in para. 20, the estimated project cost is about US$48.32 million, with US$23.85 million in foreign costs (49 percent of total costs) and US$24.47 million in local costs (51 percent of total costs). The more rapidly these technologies are being produced in Poland, the more the local cost component would increase. The project cost estimate includes a physical contingency of 10 percent and a price contingency of 2.5 percent compounded annually. Grant-financed projects are exempt from custom duties and

import taxes. Detailed estimates of project costs and cash flow are presented in Annex 13.

22. The project also benefited from a Project Preparation Advance (PPA) of US$329,000 allocated to the *Voivodship* of Krakow for the pilot projects. The PPA is excluded from the project cost estimates presented in Annex 13.

Project Financing Plan

23. For individual projects, the cost sharing from GEF, the financing plan and the mix of collateral sources would be determined case-by-case. They would depend on the individual project status within national and local priorities, the conversion technology selected, the energy-efficiency measures included, and the boiler owner's equity contribution.

24. **GEF Cost Sharing.** The GEF would provide incremental funding either to render projects with global benefits economic or to modify already viable projects to enhance the capture of such benefits. ***For the coal-to-gas conversion subcomponent***, GEF funding would provide grant elements equivalent to the additional life-cycle costs of converting existing coal-fired boilers to new, more efficient gas-fired boilers over the cost of replacing the old boilers after 25 years in service with new coal-fired boilers and of re-engineering the old installation to take advantage of privately profitable improvements in energy-efficiency. The rationale for incremental GEF funding is that, without the GEF, re-engineering and replacement with new coal-fired boilers would be optimal for the facility owners. ***For the energy efficiency subcomponent***, the GEF funding would also provide incremental grant financing for the installation of energy-efficiency equipment in new residential buildings, necessary to increase overall building efficiency above the required level set by the Polish Housing Energy-Efficiency Standards.

25. ***For the coal-to-gas conversion subcomponent***, typical coal-to-gas conversion is financially not viable for owners based on current economic conditions and incentive structures. To achieve an acceptable rate of return of 25 percent (boiler owner's cost of capital), the GEF grant should typically cover about 34 percent of the cost for the condensing boiler project and 60 percent of the cost for the cogeneration project. For the Krakow pilot projects, the estimated project costs, including project engineering and management services, are US$5.1 million for the cogeneration project and US$403,000 for the condensing boiler project. The estimated GEF contribution would be US$2.94 million for the cogeneration project and US$129,000 for the condensing boiler project. ***For the energy efficiency subcomponent***, the GEF grant would cover all costs of the incremental energy-efficiency measures. ***For the technical assistance component***, the GEF grant would also cover in totality the costs of the related assistance services. ***For the total GEF project***, the GEF contribution of US$26.0 million equivalent represents about 54 percent of the project cost. The remaining US$22.32 million (or 46 percent) represents local counterpart funding.

26. **Indicative Financing Plan.** Based on the technology mix assumed in para. 20, an indicative financing plan of US$45.93 million for the coal-to-gas

conversion subcomponent, including project engineering and management services, is presented in Annex 14. This plan consists of: (a) a GEF grant of US$23.61 million equivalent, including a prorated share from the Norwegian cofinancing (see para. 27); and (b) local counterpart financing of US$22.32 million.

27. **Norwegian Cofinancing.** The Kingdom of Norway has provided an additional cofinancing grant of NKr7.425 million, the equivalent of US$1.0 million, to the project. The intention of the Norwegian cofinancing is to provide a practical demonstration of elements of possible joint implementation arrangements under the FCCC (see Annex 15).

28. **Sources of Collateral Funding.** An assessment of the various sources of collateral financing, including their terms and conditions, is presented in Annex 7. Based on the above indicative plan and out of the required US$22.32 million counterpart funding over the project period, both the *National Fund for Environmental Protection and Water Management* (the National Fund) and *Bank Ochrony Srodowiska SA* (BOS) could participate with up to about US$15.32 million, the local *voivodships* with about US$4.0 million and the boiler owners with an equity contribution of US$3.0 million. The *Voivodship* of Krakow secured the local counterpart financing for the pilot projects in Krakow. The National Fund and BOS provided commitments to the Bank on their participation in the financing of the overall GEF project.

29. **Guarantee Requirements.** It has been customary for local Polish banks to require cascading layers of guarantees from public entities (*voivodships* and/or *gminas*) for all loans (public and private). This practice presents a barrier for access to development funds and is unnecessary since the GEF would substantially grant finance the installation of new equipment. When the participating boiler owner is not a public institution, the lending institutions contributing to the counterpart fund should not require guarantee(s) from regional and local authorities (*voivodships* and/or *gminas*). Rather, the lending institutions should require alternative guarantee schemes such as collateral on the new assets or an escrow account for the revenue stream generated by these assets and secured through long-term sales contracts. Such schemes should be applied first to meet debt service repayment (principal plus interest). Agreement was reached with BOS that it will use alternative guarantee schemes for all projects involving private owners, as a substitute for guarantees from public entities (*voivodships* and/or *gminas*).

Project Implementation

30. **Project Organization and Implementation Structure.** A comprehensive project organization and implementation structure, including overall project supervision and monitoring, is presented in Annex 7. This structure is designed to cope with the complexity that may eventually arise from multiple individual boiler conversion projects distributed nationwide and to establish the institutional framework that would allow replication of the GEF concept throughout Poland. The structure presented in Annex 7 defines the technical, administrative and financial roles and responsibilities of the key participants in the proposed GEF project needed to establish a framework for replicability.

In addition, it may well be used for future GEF-type operations. A summary description of the project organization and implementation structure, including key project participants and project implementation arrangements, follows.

31. **The Grant Recipient.** The Ministry of Environmental Protection, Natural Resources and Forestry (MoE), through its Department of Ecological Policy, would be responsible for: (a) overall coordination and implementation of this project; and (b) monitoring and reviewing project activities and products to assure that they are of a high quality and are accomplished in a cost-effective and timely manner.

32. **The Implementing Agency.** BOS would serve as the implementing agency for this project. BOS would not be used as an intermediary bank that would use the proceeds of the GEF grant for lending purposes, but rather as an administrator of project activities and funds to be used solely for the purposes of the project. BOS would receive a management fee to cover its administrative costs. BOS would also receive assistance from qualified consultants in selected areas of project appraisal, implementation and management.

33. About 80 percent of BOS staff is in regional offices throughout Poland. Through its already established network of branches, BOS would: (a) supervise implementation of the pilot projects in Krakow; (b) promote the GEF concept nationwide; (c) receive and evaluate applications for financing under the project; (d) submit proposals for review and clearance to a national Scientific and Technical Advisory Panel (STAP) composed of foreign and Polish experts, which will evaluate the projects' eligibility for GEF financing; (e) act as syndicator of funds for each individual coal-to-gas conversion project determined to be eligible for GEF financing by assisting the project owners in obtaining the required collateral funding; (f) appraise individual projects, supervise their implementation and monitor performance results following a set of procedures and guidelines documented in a GEF Project Operations Handbook to be developed under the first GEF pilot projects in Krakow; and (g) administer and channel funds from the GEF project to the prospective beneficiaries through monitorable accounts designated for these purposes only. BOS could also participate as a source of collateral funding for each of the individual projects, using its own funds, based on its standard terms and conditions for investment loans (see Annex 7).

34. Individual investment projects would be evaluated in the order they are received, without pre-set limits per *voivodship* or per project. The project owners would implement the projects under the supervision of BOS and with the assistance of technical advisors to the GEF project and of qualified consultants acting as representatives of the owners in selected areas of project management, engineering design, procurement, supervision of construction work, installation, testing and commissioning, and monitoring of project environmental and technical performance.

35. **Beneficiaries.** The beneficiaries of the GEF grant could be: (i) public and private owners of non-industrial boilers, such as housing cooperatives, district heating enterprises, hospitals, universities; and (ii) new residential building owners who have secured construction financing. Industrial boilers are excluded

because this would require further complicated analyses of the business prospects of each industry.

36. **Grant and Project Agreements.** The legal arrangements under this project will consist of: (a) a Grant Agreement between the Bank and MoE; (b) a Project Agreement between MoE and BOS; and (c) a Sub-Grant Agreement for each individual project between BOS and prospective grant beneficiaries. The Grant Agreement would make references to the Loan Agreement for the associated World Bank project (see para. 15) and to the Norwegian cofinancing arrangement. A Letter of Agreement was signed on September 30, 1993 between the Governments of Norway and Poland on financial cooperation for this project. Agreement was reached with MoE on the terms of the Project Agreement. Agreement was reached that MoE shall establish the Scientific and Technical Advisory Panel and monitor the GEF project.

37. **Project Implementation Period and Disbursement.** The project would be implemented during FY1995-2000. The project's completion date is expected to be June 30, 2000 and the closing date December 31, 2000 (see Annex 18). Once selected, a high-efficiency condensing boiler project and a cogeneration project would take about 18 and 24 months to complete, respectively. In this context, identification and appraisal of follow-on individual projects would be done within the first three years of the project implementation period. Standard Bank disbursement procedures would be followed, with established limits on initial levels of deposit and replenishment for the Special Account, Statements of Expenditures and Bank review (see Annex 17).

38. **Project Performance.** The maximum total amount of GEF grant assistance available for coal-to-gas conversion activity is US$26.0 million equivalent, of which about US$24.5 million is for the investment component. Potential coal-to-gas boiler conversion projects in Poland far exceed that amount. Even those limited GEF funds could, however, be significantly scaled down if only a few solid individual projects are identified and their counterpart financing secured within the first three years of the GEF project. About 13 percent of the GEF project funds are already committed for the pilot projects in Krakow. To ensure satisfactory performance in project identification and appraisal and in the disbursement of the GEF funds, targets for cumulative commitment levels for the GEF grant related to the investment component of the GEF project would be set as follows: (a) 14 percent (or US$3.4 million equivalent) by the end of the first year; (b) 64 percent (or US$15.7 million equivalent) by the end of the second year; and (c) 100 percent (or US$24.5 million equivalent) by the end of the third year. Unless the Bank otherwise agrees, the uncommitted portion of the overall GEF grant as of the beginning of the fourth year would then be cancelled.

39. Based on the technology mix assumed in para. 20, an estimated 160 MWt of boiler capacity are expected to be converted under this project. This level is only about 1 percent of the total capacity of small and medium boiler houses in Poland. Therefore, the risk of not identifying suitable follow-up conversion projects is minimal.

40. **Monitoring and Evaluation of Results.** Because of its importance within the GEF pilot phase, it is expected that this project would be intensively reviewed by GEF participant countries for potential replicability. Thus, a comprehensive monitoring and evaluation program was developed and would be implemented from the earliest project stages, to ensure that an accurate and detailed assessment of project impacts and benefits would be fully available. This program, as outlined in Annex 11, was set up in accordance with established international monitoring and project evaluation procedures, protocols and requirements. Recognizing the importance of this activity for producing verifiable project results, MoE would be responsible for this portion of the project and would use the services of a contractor acceptable to the Bank for the monitoring of individual conversion projects. The monitoring activities would be funded by the GEF grant.

41. Agreement was reached with MoE on the monitoring and evaluation program. ***For the coal-to-gas conversion subcomponent***, monitoring of individual projects should include pre- and post-conversion calculations and measurements of: (a) greenhouse gas emissions; (b) other air pollutants; (c) ambient air quality, where monitoring systems have been established; and (d) technical performance. ***For the energy efficiency subcomponent***, monitoring of individual projects should include, inter alia, a quality control program to assure that the energy-efficiency and conservation measures are actually installed and operating properly. The sub-grant agreement for each individual project would include the development of a related monitoring plan consistent with the program as a condition of disbursement.

42. **Rules and Procedures for Processing Individual Project Applications.** Typical rules and procedures have been identified for accomplishing individual conversion projects. A typical flow of activities for a single project is described in Annex 8.

43. **Project Set-up and Management.** Given the number of project preparation activities, BOS has already assigned the staff necessary to set up a GEF project team. During project preparation and subsequently during project implementation, focused training would be required to assist the BOS team and other major participants in the project in: (a) Bank procurement and disbursement procedures; (b) implementation of the marketing plan for a comprehensive promotion of the GEF project immediately after effectiveness of the GEF grant; (c) establishing standardized identification, technical and environmental requirements and application procedures for follow-on investments; (d) preparation of elements of the GEF Project Operations Handbook; and (e) monitoring of the implementation of the pilot projects in Krakow, assisted by qualified representatives of the boiler owners. Project implementation activities are described in Annex 12. Agreement was reached with BOS on the marketing plan and its implementation.

44. **Procurement Responsibilities and Strategy.** Individual projects would likely be geographically distributed and would have separate project owners. Procurement of goods, works and services for individual projects would be carried out independently by the project owners. BOS central office would coordinate and supervise all procurement activities under the GEF project. As prospective

beneficiaries of the GEF fund, the project owners would be assisted by qualified consultants on procurement matters (see para. 34). ***For the coal-to-gas conversion subcomponent***, each conversion project would be procured on the basis of a single responsibility contract involving engineering, procurement and construction (EPC contract). It would permit well coordinated project implementation. EPC contractors would be post-qualified. Only single-stage bidding procedures would be followed under this project. A pre-bid conference would be, however, required for the procurement of each EPC contract. EPC contracts would be awarded following: (i) international competitive bidding (ICB) procedures for conversion projects involving cogeneration systems; and (ii) limited international bidding (LIB) procedures for conversion projects involving high-efficiency boiler systems. ***For the energy efficiency subcomponent***, each energy-efficiency project would involve several procurement sub-packages of off-the-shelf goods that are readily available. Given the relatively low value of these sub-packages, they would be procured individually following international and local shopping procedures.

45. **Procurement Arrangements.** The World Bank's Procurement Guidelines and the now mandatory Standard Bidding Documents would be followed in all procurement of goods, works and services to be financed by the GEF grant (including the Norwegian cofinancing). Procurements of goods from domestic suppliers and manufacturers, and contracts for services and works from domestic firms and contractors, are possible. Under the ICB procedures for goods only, and for purposes of evaluation and comparison of bids, Polish manufacturers would receive a domestic preference margin of 15 percent of the CIF price or the prevailing customs duty applicable to non-exempt importers, whichever is less, provided they can prove that the value added to the product in Poland exceeds 20 percent of the ex-factory bid price. BOS would closely monitor all procurement activities and ensure compliance with the Bank's Guidelines. The procurement arrangements and schedule are detailed in Annex 16.

46. **Project Reporting.** Each sub-grant agreement would include reporting requirements from grant beneficiaries to BOS. In turn, BOS would carry out project implementation monitoring and documentation for each individual project and for the overall project. Agreement was reached that BOS would furnish to MoE and the Bank: (a) by November 30 and May 31 of each year, progress reports on the status of the overall project, with brief information on individual projects; (b) a project completion report for the overall project to be submitted within six months after the project closing date; and (c) a project completion report for each individual project eighteen months after the acceptance of the individual project by the owner.

47. **Project Auditing.** The Project Account, the Special Account and the Statement of Expenditures would be audited at the end of each fiscal year in accordance with international standards. Agreement was reached that BOS would appoint independent external auditors acceptable to the Bank and present within six months after the end of each fiscal year, the audited Project Account, the Special Account and Statement of Expenditures.

48. **Project Supervision.** As part of its responsibility to administer the GEF grant, the Bank would carry out regular supervision missions. The project implementation and supervision action plans are presented in Annex 18.

Project Sustainability

49. The introduction of improved technologies would facilitate the Government's efforts to pursue its environmental priorities and standards aggressively and to take full advantage of the macroeconomic conditions and other incentives that induce energy efficiency and conservation. With largely decontrolled coal prices, a proper gas pricing policy, rising labor costs, and proper set-up and enforcement of environmental fees and fines that reflect the true costs of environmental damage, coal-to-gas conversion would become a financially attractive and self-supporting option. The GEF activity could be made more self-sustaining if support were provided to develop an independent power market based on small gas-fired cogeneration systems, high-efficiency boilers and advanced energy-efficient building equipment -- insulation, glazing, lighting and appliances -- that are widely available.

Rationale for GEF Funding

50. The scope for using innovative technologies such as high-efficiency gas-fired boilers and packaged gas-fired cogeneration units and for integrating improvements in heat energy supply, distribution, and transfer systems and in end-use efficiency in buildings to improve the cost-effectiveness of the abatement of CO_2 emissions needs to be demonstrated through pilot investments. Although the technologies are well-established, their development in Poland and in other Central and Eastern European countries has so far been limited.

51. The present GEF activity is designed as a catalyst to stimulate self-replicable technological and institutional changes that would promote coal-to-gas conversion in small and medium-size boilers and induce more energy-efficient practices in the architectural design and operation of new residential buildings. The techniques, once successfully demonstrated in Poland, are replicable in the large number of coal-dependent/intensive transition economies that have access to gas supplies.

Environmental Aspects

52. **Environmental Screening Classification.** The proposed project has been placed in environmental screening category "B," consistent with the provisions of Operational Directive 4.01, "Environmental Assessment." The project was subject to an environmental review for the demonstration activities and environmental guidelines have been developed for use in the GEF Project Replicability Framework to be established under the project (see Annex 9). The proposed demonstration activities have received clearance from the Environmental Protection Department of Krakow, which has authority for projects of this type and scale under Polish environmental procedures. It should be noted that an "Environmental Assessment of the Gas Development Plan for Poland" was prepared in 1991 to support evaluation of environmental issues associated with the

development of policies and technical programs for substituting gas for coal in Poland.

53. **Potential Environmental Impacts**. Implementation of the proposed project would result in accelerated implementation of the Government of Poland's policy of converting small and medium-size coal-fired boilers to the use of gas to reduce serious air pollution problems in major urban-industrial areas, with resulting local benefits to air quality and public health. On a regional scale such interventions would incrementally support the reduction of SO_2 emissions and contribute to a reduction of CO_2 emissions on a global level. The use of high-efficiency boiler technology would also reduce the total level of energy used and reduce the rate of exploitation of domestic gas reserves and the level of natural gas imports.

54. **Environmental Benefits from Pilot Projects**. Implementation of the proposed pilot activities in Krakow would have a positive impact on local air quality, especially during the winter heating season, and would contribute on an incremental basis to improved air quality on a regional basis. In addition, these projects would complement the ongoing program in the City of Krakow to reduce pollution from small and medium-scale boiler houses. Implementation of the two pilot activities in Krakow would reduce the use of coal by 4,238 tons per year and replace it with clean burning natural gas, which would further improve ambient air quality in the historic city center. On a local and regional level, the change in fuel types and the introduction of higher efficiency boilers would result in an average annual reduction in emissions of SO_2 by about 118 tons and particulates by about 80 tons. The pilot activities would have global benefits by reducing CO_2 emissions by an estimated 10,050 tons per year.

55. **Potential Adverse Impacts**. The primary potential adverse environmental impacts associated with the proposed project are: (a) waste management issues associated with the handling and disposal of asbestos wastes during the removal of the old boilers; and (b) the risk of explosion associated with the piped delivery and use of gas in boilers. Both these issues are well-recognized in Poland, and proper procedures would be used in the proposed project for the safe handling and disposal of asbestos and for assuring the safe installation and operation of the gas supply systems and gas-fired boilers. The pilot activities would include specific provisions to address these issues, and the environmental guidelines for the GEF Project Replicability Framework require that these issues be reviewed case-by-case.

56. **Institutional Strengthening**. The proposed project would contribute to a strengthening of Poland's capacity, at the national and local levels and in the areas selected for project-supported conversion activities, to: (a) plan and implement, on a national basis, the innovative and cost-effective types of environmental improvement activities being supported under the proposed GEF project; (b) develop experience with the design, installation and operation of interventions to improve the heat supply system; (c) create an institutional capability to assess global externalities such as CO_2 emission abatement in project analyses; and (d) improve the implementation of public awareness programs for energy efficiency and conservation.

Project Benefits

57. The assumptions and methodology for determining the project benefits, the GEF incremental cost-sharing and the marginal cost of net CO_2 abatement are presented in Annex 19. A summary of the results follows.

58. **For the coal-to-gas conversion subcomponent.** With energy conservation measures included, the proposed GEF project could achieve up to a 67-71 percent reduction in CO_2 emissions compared with the old existing boiler facilities. Based on the technology mix assumed in para. 20, and extrapolating to the overall GEF project on the basis of the Krakow pilot projects, the GEF coal-to-gas conversion subcomponent would have several outcomes. The first is local benefits through the elimination of about 45,000 tons of coal burned annually. This reduction would improve ambient air quality locally and regionally by reducing the annual emissions of SO_2 and particulates by about 820 and 860 tons, respectively. Second, global benefits would result from a reduction of CO_2 emissions of about 100,000 tons per year. The marginal cost of the net CO_2 abatement is US$37 per ton of CO_2 reduced for the condensing boiler project and US$67 per ton of CO_2 reduced for the cogeneration project.

59. **For the energy efficiency subcomponent.** The energy efficiency and conservation measures in new residential buildings would lead to energy savings of about 27-31 percent and a reduction in equivalent CO_2 emissions of about 28-40 percent. The marginal cost of the net CO_2 abatement is about US$187 per ton of CO_2 reduced.

Project Risks

60. The project risks include: (a) delays in obtaining local counterpart financing; (b) institutional barriers or inefficiency in promoting and replicating the GEF concept; (c) delays in implementing the first GEF pilot projects; and (d) impact of price variation between cost estimates and actual bid prices for individual projects on the GEF grant to be allocated (see para. 61).

61. These risks have been minimized by: (a) securing the local counterpart financing for the pilot projects and receiving firm commitments from both the National Fund and BOS on their participation in the financing of the overall GEF project; (b) facilitating access to local counterpart funding for private boiler owners by establishing acceptable guarantee requirements from the local lending institutions; (c) starting implementation of a nationwide marketing program of the GEF project immediately after effectiveness of the GEF grant; (d) proceeding immediately with the hiring of qualified engineering consultants to act as representatives of boiler owners for the pilot projects in Krakow; and (e) revising the GEF grant amounts based on the actual costs of individual projects from bids received.

POLAND - COAL-TO-GAS CONVERSION PROJECT

Estimated Costs and Financing Plan

Estimated Costs

PROJECT COMPONENTS	US$ Million		
	LOCAL	FOREIGN	TOTAL
A. Investment Component			
A.1 Coal-to-Gas Conversion Program			
- Cogeneration Systems	14.94	10.08	25.02
- High Efficiency Boiler Systems	6.27	6.46	12.73
Sub-total - Conversion Program	21.21	16.54	37.75
A.2 Energy Efficiency Fund		0.93	0.93
Subtotal - Investment Component	21.21	17.47	38.68
B. Contractual Services			
B.1 Environmental Monitoring		0.25	0.25
B.2 Marketing Program		0.15	0.15
Sub-total - Contractual Services		0.40	0.40
C. Technical Assistance			
C.1 Engineering and Project Management Services		2.07	2.07
C.2 BOS Management Fee		0.62	0.62
C.3 Technical Advisors (STAP)		0.19	0.19
C.4 Energy Auditing Services		0.05	0.05
C.5 External Financial Auditing Services		0.06	0.06
C.6 Training and Other Consulting Services		0.14	0.14
Sub-total - Technical Assistance		3.13	3.13
D. PROJECT BASE COSTS	21.21	21.00	42.21
E. Contingencies			
E.1 Physical Contingency	2.12	1.86	3.98
E.2 Price Contingency	1.14	0.99	2.13
Sub-total - Contingencies	3.26	2.85	6.11
F. TOTAL PROJECT COSTS	24.47	23.85	48.32

Financing Plan

FINANCING SOURCES	US$ Million Equivalent		
	LOCAL	FOREIGN	TOTAL
GET Fund /a	2.15	23.85	26.00
Local Sources	22.32		22.32
TOTAL	24.47	23.85	48.32

Note: /a Includes cofinancing grant of US$1.0 million equivalent from the Kingdom of Norway.

POLAND - COAL-TO-GAS CONVERSION PROJECT

Procurement Arrangements and Disbursements
(US$ Million)

Procurement Arrangements

PROJECT COMPONENTS	PROCUREMENT METHODS /a ICB	LIB	LCB	OTHER /b	TOTAL
GOODS, WORKS AND MATERIALS					
A. Cogeneration Systems	29.10 (16.90)				29.10 (16.90)
B. High Efficiency Boiler Systems		14.76 (4.64)			14.76 (4.64)
C. Energy Efficiency Equipment for New Residential Buildings				0.93 (0.93)	0.93 (0.93)
CONTRACTUAL SERVICES					
E. Environmental Monitoring			0.23 (0.23)	0.02 (0.02)	0.25 (0.25)
F. Marketing Program			0.14 (0.14)	0.01 (0.01)	0.15 (0.15)
TECHNICAL ASSISTANCE					
G. BOS Management Fee				0.62 (0.62)	0.62 (0.62)
H. Technical Advisors (STAP)				0.19 (0.19)	0.19 (0.19)
I. Energy Auditing Services				0.05 (0.05)	0.05 (0.05)
J. External Financial Auditing Services				0.06 (0.06)	0.06 (0.06)
K. Training and Consulting Services				2.21 (2.21)	2.21 (2.21)
TOTAL	29.10 (16.90)	14.76 (4.64)	0.37 (0.37)	4.09 (4.09)	48.32 (26.00)

/a ICB: International Competitive Bidding; LIB: Limited International Bidding; and LCB: Local Competitive Bidding.
Figures in bracket indicate amounts in US$ million equivalent to be financed from GET and Norwegian grants.

/b Includes:
(1) International & Local Shopping (aggregate amount US$0.93 million equivalent)
(2) Direct Contracting (aggregate amount US$0.03 million equivalent)
(3) Training & Consulting Services (aggregate amount US$3.13 million equivalent) awarded in accordance with Bank Guidelines for Use of Consultants.

Disbursement Schedule
(Includes Norwegian Grant)

IBRD FY	US$ Million Equivalent FY95	FY96	FY97	FY98	FY99	FY2000
Annual	0.46	3.13	8.38	9.45	4.13	0.46
Cumulative	0.46	3.59	11.97	21.42	25.55	26.00
Percentage	1.8%	13.8%	46.0%	82.4%	98.3%	100.0%

POLAND - COAL-TO-GAS CONVERSION PROJECT

Disbursement Categories

CATEGORY	Amount of the GET Grant Allocated (expressed in SDR)	Amount of the Norwegian Grant Allocated (expressed in NKr)	% of Expenditures to be Financed
A. Goods, Civil Works and Materials	11,980,000	5,140,000	100% of foreign expenditures, 100% of local expenditures (ex-factory), and 85% of local expenditures for other items procured locally.
B. Contractual Services	260,000	114,000	100%
C. Project Administration Fees	410,000	177,000	100%
D. Training and Consulting Services	1,660,000	717,000	100%
E. Unallocated	2,890,000	1,277,000	
TOTAL	17,200,000	7,425,000	

POLAND - COAL-TO-GAS CONVERSION PROJECT

Time Table of Key Project Processing Events

(a)	Time taken to prepare	30 months
(b)	Prepared by	The World Bank
(c)	Identification Mission	October 24, 1991
(d)	Pre-Appraisal Mission	March 10, 1993
(e)	Appraisal Mission	May 31, 1993
(f)	Negotiations	August 29 - September 2, 1994
(g)	Planned date of effectiveness	December 1994
(h)	Expected date of Completion	June 30, 2000

Part II: Technical Annexes

TECHNICAL ANNEXES

Annex 1: Document Available in the Project File

Annex 2: Emissions from Stationary Sources in Poland

Annex 3: Technology Options

Annex 4: Criteria for Eligibility and Selection of Priorities

Annex 5: Selection of the First GEF Boiler Pilot Projects

Annex 6: Description of the Krakow Pilot Projects

Annex 7: Project Organization Structure and Institutional Replicability

Annex 8: Rules and Procedures for Processing Applications

Annex 9: Environmental Aspects

Annex 10: Residential Energy Efficiency

Annex 11: Environmental Monitoring Program

Annex 12: Project Implementation Activities

Annex 13: Project Costs

Annex 14: Indicative Financing Plan

Annex 15: Norwegian Co-Financing

Annex 16: Procurement Arrangements and Schedule

Annex 17: Disbursement Schedule

Annex 18: Project Implementation Plan

Annex 19: Financial Analysis

Annex 20: Technical Assistance

Annex 21: Scientific and Technical Advisory Panel - Terms of Reference

Annex 22: Boiler Owners' Representative - Terms of Reference

Annex 23: Operations Handbook Consultant and Application Processing Consultant - Terms of Reference

Annex 24: Local Experts and Members of the Technical Advisory Groups - Terms of Reference

Annex 25: Marketing Plan - Terms of Reference

Map No: IBRD 25145

POLAND - COAL-TO-GAS CONVERSION PROJECT

Documents Available in the Project File

1. Economic and Financial Model for GEF - Coal-to-Gas Conversion Project, The World Bank, May 1994.

2. Source of Air Pollutants emission in the region of Krakow City, UNICO Services Ltd., Krakow, March 1993.

3. Boiler Coal-to-Gas Conversion and Total Energy Housing complexes in Krakow, Evaluation of Proposals and Recommendations, Stadwerke Mannheim SMA, Mannheim, February 12, 1994

4. Coal-to-Gas Conversion Project, Preliminary Report on Proposals in Krakow, World Bank, EC2EE, Washington, D.C., September 1992

5. Proposal for Coal-to-Gas Conversion of Boilerhouse in the City of Krakow, Trzebinia, Chrzanon and Libiaz, Krakow Development Office, Krakow, July 1992.

6. Proposal for Heating of Housing Estates using Natural Gas as Principal Energy Medium for the Cities of Krakow, Tarnow, Krakow, Development Office, July 1992.

7. Economic Modeling and Analysis of Heating System Alternatives in Krakow, CityProf, Krakow, May 1992.

POLAND - COAL-TO-GAS CONVERSION PROJECT

Emissions from Stationary Sources - 1990 Estimates (in thousand of tons per year)

No.	Voivodship	SO2		NOx		Dust		CO2 from boiler houses	
		Total	from boiler houses	Total	from boiler houses	Total	from boiler houses	million tons	ton/km2
1	POLAND	3098	764	800	100	1950	519	132	421
3	Biala Podlaska	8	6	1	1	6	4	1.0	192
4	Bialystok	31	15	6	2	24	10	2.6	257
5	Bielsko-Biala	36	14	10	2	52	9	2.4	651
6	Bydgoszcz	82	29	27	4	76	20	5.0	482
7	Chelm	10	5	5	1	23	3	0.9	223
8	Cienachow	13	9	2	1	9	6	1.6	244
9	Czestochowa	35	18	8	2	31	12	3.1	502
10	Elblag	17	7	5	1	26	5	1.2	197
11	Gdansk	70	30	20	4	50	21	5.2	698
12	Gorsow-Wielkopolski	19	7	7	1	30	5	1.2	142
13	Jelenia Gora	188	9	14	1	109	6	1.6	356
14	Kalisz	22	14	4	2	18	10	2.4	372
15	Katowice	582	80	175	10	327	54	13.8	2076
16	Kielce	54	20	17	3	41	14	3.5	374
17	Konin	139	11	26	1	72	8	1.9	371
18	Koszalin	14	11	2	1	11	8	1.9	223
19	Krakow	92	19	49	2	88	13	3.3	1006
20	Krosno	12	6	4	1	11	4	1.0	181
21	Legnica	77	10	11	1	51	7	1.7	425
22	Leszno	17	12	3	2	12	8	2.1	499
25	Lodz	69	27	17	4	51	18	4.7	3065
24	Lomza	18	9	4	1	14	6	1.6	232
23	Lublin	62	30	23	4	48	20	5.2	759
26	Nowy Sacz	14	12	3	2	11	8	2.1	371
27	Olsztyn	24	18	4	2	16	12	3.1	251
28	Opole	72	19	26	2	75	12	3.3	383
29	Ostroleka	37	6	20	1	21	4	1.0	160
30	Pila	16	9	3	1	14	6	1.6	190
31	Piotrkow Trybunalski	367	16	79	2	50	11	2.8	440
32	Plock	86	10	12	1	37	7	1.7	337
33	Poznan	41	21	9	3	32	14	3.6	444
34	Przemysl	8	5	2	1	6	4	0.9	194
35	Radom	100	14	28	2	45	9	2.4	331
36	Rzeszow	23	12	6	2	14	8	2.1	472
37	Siedlce	16	13	2	2	12	9	2.2	264
38	Sieradz	16	9	3	1	18	6	1.6	318
39	Skierniewice	12	7	2	1	8	5	1.2	305
40	Slupsk	11	6	2	1	7	4	1.0	139
41	Suwalski	14	9	3	1	10	6	1.6	148
42	Szczecin	124	20	32	3	72	14	3.5	345
43	Tarnobrzeg	123	11	29	2	44	8	1.9	302
44	Tarnow	30	10	16	1	35	7	1.7	416
45	Torun	35	18	8	2	22	12	3.1	579
46	Walbrzych	32	14	8	2	37	9	2.4	580
2	Warsaw	114	54	34	7	97	37	9.3	2439
47	Wloclawek	26	11	6	1	18	7	1.9	432
48	Wroclaw	59	25	17	3	47	17	4.3	688
49	Zamosc	12	7	2	1	7	5	1.2	173
50	Zielona Gora	19	10	4	1	15	7	1.7	194

Source: Ministry of Environmental Protection, Natural Resources and Forestry, June 1993.

CO2 emissions are estimated from SO2 emissions according to the following assumptions about coal used in boilerhouses:

sulfur content	0.8%	CO2 emission factor	92 kg/GJ
sulfur emitted as SO2	80%	*Conversion factor*	173 tCO2/tSO2
calorific value	24 GJ/ton		

POLAND - COAL-TO-GAS CONVERSION PROJECT

Technology Options

Introduction

1. This annex describes the technology options for converting existing coal-fired boilers to natural gas-firing and for improving the energy efficiency of the heat distribution and transfer systems and the end-user facilities served by the converted boilers. The technology options considered under the GEF project and summarized below are particular to the small scale heating systems, including small heat-only-boilers (HOBs) and small combined heat and power (CHP) systems.

2. Replacing coal with natural gas (which is principally methane) reduces emissions of carbon dioxide (CO_2) per unit of heat produced by about 43 percent. The reason is that natural gas, although it contains carbon, derives a greater percentage of its heating value from its hydrogen content, which is greater than that of coal, which is mostly carbon. When hydrogen burns, it yields only water, an environmentally benign substance. Firing with natural gas permits use of more efficient boilers, as well as even more effective and clean-burning engine and gas-turbine powered CHP facilities. Use of gas virtually eliminates emissions of pollutants of local and regional concern, such as particulates and sulfur dioxide (SO_2), and reduces nitrogen oxides (NOx) emissions to no more than a few percent of those that would occur with existing coal-fired boilers providing the same service. Finally, for a new or complete replacement installation, firing with natural gas from a gas delivery point at the site could reduce the investment cost by half, as compared with the cost of new coal-fired facilities.

3. **Objective**. This project would pioneer the reduction of atmospheric CO_2 emissions from district heating HOBs in Poland by replacing coal with natural gas. Emissions of CO_2 already reduced through the use of a fuel with a lower carbon content would be further reduced because of the improved fuel-use efficiency opportunities in both boilers and modern CHP facilities, which are made possible by natural gas. The associated heat distribution and transfer systems would be rehabilitated and upgraded, and energy-saving measures and practices introduced in the end-user facilities served by the heating system to complement and further improve overall system efficiency and concurrent reductions of CO_2 emissions.

4. **Opportunities**. Natural gas offers the opportunity for much higher boiler efficiencies or for utilizing gas turbines (turbines) or piston engines (engines) to drive electric power generators. These power-generating sets can be equipped with unfired heat recovery boilers to meet district heating needs. Heat recovery boilers require only modest quantities of additional fuel to meet peaking requirements or to compensate for abnormal operating conditions, such as an outage of the engine or gas turbine.

5. Where both electricity and heat can be produced at the same facility, such modern CHP facilities burn less fuel and produce less CO_2 for the same heating input and for the same electric power and heat output as any commercial technology available for meeting either demand separately. The electric power generated may be sold and delivered to a power distributor, or it may be utilized in the owner's facilities.

6. At locations where CHP facilities are not feasible, high-efficiency gas-fired HOBs can be used. Condensing boilers are the most efficient of any commercially available technology.

7. Candidate Projects. The oldest boilers -- those at or near the end of their useful life -- may be replaced either with newer, more efficient condensing boilers or with gas turbine- or engine-powered CHP facilities. Boilers with a substantial remaining useful life may be considered for modification to burn gas and upgraded to improve efficiency as an alternative to replacing them with new boilers. Further evaluations may indicate that some of these newer coal-fired boilers could be suitable for upgrading and modification to serve as heat recovery boilers for turbine or engine additions.

8. Menu of Options. Table 3-1 of this annex presents a non-exhaustive list of conversion options for the different conditions at existing boilers and the projected reductions in CO_2 emissions and fuel use. The comparisons are based on a 1 MWt of useful heat delivered by the boiler. The examples used for comparison are generally representative of the performance that could be expected for each system, but should not be considered as precise performance of a specific design for a specific situation.

9. Cost-Savings - Accelerated Implementation Schedule. An accelerated implementation schedule for converting existing boilers may be achieved by arranging for a "standard" or "typical" conversion engineering package, to be prepared for use by many interested parties. Furthermore, many of the conversion technologies considered in this project may be largely pre-assembled and tested so as to require minimum effort of on-site assembly. The use of packaged solutions would save time and resources.

10. Market for the Technology Considered. There are many manufacturers and suppliers of small heating systems, and most of them offer design features peculiar to the heating equipment (such as boiler, engine, turbine, heat exchanger, automation and control) of that manufacturer or supplier. There are also several "packagers" who engineer, assemble, test and supply ready-to-run heating units. This results in considerable variations in the technical and environmental performance of the many heating systems in service that are offered by the manufacturers, suppliers and packagers. Further, as new technology develops, the design and assembling of heating equipment continues to be improved.

Boiler Technologies

11. **Condensing Economizers**. Condensing economizers are commercially available and can be added to either new or existing boilers in good condition whether fired with coal, oil or gas. Condensing economizers recover heat at a lower temperature by further cooling the combustion gases before they exit from the chimney. At these lower temperatures the considerable quantities of water vapor in the gases are condensed to liquid. The heat recovered from every 10 kilograms of water vapor condensed saves about 1 kilogram of coal.

12. These versatile devices are already proven in coal-fired boiler technology and could be added to existing coal-fired boilers in good condition without converting to natural gas. Although this approach falls outside the scope of this GEF project, its feasibility should be considered because it may offer broad opportunities to improve economically the efficiency of coal use and concurrently reduce emissions from those boilers that may continue in operation for some years.

13. **Conversion from Coal-firing to Natural Gas-firing**. Converting existing coal-fired boilers in good condition to natural gas-firing, rehabilitating the outer casing to control air in-leakage and adding commercially available high-efficiency condensing economizers may be more economical than replacing some boilers. Substituting clean natural gas for coal would avoid future deterioration from coal-firing. With proper care and maintenance, this substitution should extend boiler life for several years beyond what could be achieved with coal-firing, significantly reduce emissions of CO_2 and other pollutants, and improve the efficiency of fuel use.

14. One of the technologies considered in this project includes high efficiency natural gas-fired condensing boilers with thermal efficiencies of up to 95 percent. The condensing boiler is designed and constructed to recover essentially all available heat by cooling the combustion gases and, in addition, recouping the heat released by the condensation of moisture within the boiler. With proper care and maintenance, the service lifetime of this boiler should substantially exceed that of coal-fired boilers. Unique design features include greatly increased heat transfer surface, use of corrosion-resistant materials and provisions for the collection and drainage of condensate. Condensing boilers with efficiencies approaching 95 percent, with capacities of about 300-500 kilowatt-thermal (kWt), are available in Europe at about US$180/kWt at the factory. This cost is about twice that of a gas-fired boiler of similar capacity designed for about 84 percent thermal efficiency.

15. **Use of High-efficiency Boilers together With Condensing Economizers**. Effective use of high efficiency boilers with add-on condensing economizers requires some beneficial use of the near-ambient low level heat that can potentially be recovered by these boilers. For example, when the return flow of the heating system approximates 35°C, up to about half the heat from the condensation of the moisture in the combustion gas could be recovered, depending on specific conditions. However, if the warm return water from a district

heating system reaches about 70°C, much less heat from the condensation can be recovered unless a supplementary cooling medium, such as, possibly outside air, is drawn in for combustion through a condensing economizer serving as an air pre-heater.

Gas Turbine and Engine Technologies

16. Factory Pre-assembled "Packaged" Units. Several equipment manufacturers and some independent contractors offer complete, competently engineered packaging services, including operation and testing of engine and turbine generator sets with heat recovery boilers, including auxiliaries, at the assembly shop before shipping. The "package" option minimizes many common contractor and subcontractor problems and the time elapsed between placing an order to commissioning and placing the equipment into commercial service. Packaging services are also available for boilers and for engine and turbine generating sets.

17. Gas turbines are similar to steam turbines in design and function except that they utilize very hot gases, usually combustion gases, rather than steam. They operate at gas inlet temperatures up to 1,300°C and even higher with the newest machines. Usually steam turbines operate at no more than about 500°C. Efficiencies for gas turbine sets operating alone range from about 15 percent for the smaller and lower inlet temperature machines (about 200 kilowatt-electric (kWe)) to more than 40 percent for the newer and larger machines now available in single shaft capacities of about 200 Megawatt-electric (MWe). Gas turbines are probably best known as aircraft "jet" engines and "prime movers" for driving electrical generators, but they also drive gas pipeline and refrigeration plant compressor stations.

18. Reciprocating (piston type) engines (engines) utilizing natural gas as fuel operate efficiently, cleanly and reliably, releasing less CO_2 than their petroleum-fueled counterparts. Their efficiencies range from about 20 percent in the smaller capacity range (about 50 kWe) to about 40 % in larger capacities (from about 1-10 MWe). Reciprocating engines are built up to about 50 MWe. Few, if any, of the engines larger than about 5 MWe using natural gas are found in commercial service.

19. Unfired heat recovery boilers can be used to capture and utilize the considerable quantities of energy rejected in turbine and engine exhaust gases at about 450 to 500°C. The percentage of heat rejected varies from about 60 percent of the total energy in the fuel burned for an engine or turbine (up to perhaps 5 MWe) to about 85 percent for a small gas turbine (as low as 50 kWe). The energy captured in heat recovery boilers can be effectively utilized for such purposes as district heating or providing process steam for an industrial plant without any need to burn additional fuel unless the heat requirement exceeds about 1-2 Megawatt-thermal (MWt) of heat for every 1 MWe of electrical generation, depending on specific system characteristics.

20. Advanced CHP units utilizing natural gas offer thermal efficiencies that can approach 80 percent. Either a gas turbine or an engine drives an electrical generator and exhausts to an unfired heat recovery boiler for supplying district heat or industrial energy.

21. The efficiencies achievable in heat recovery boilers in advanced CHP systems will be limited by the temperature of the return water from the district heating system unless special circumstances permit beneficial recovery and use of this low level heat by an independent and unrelated activity (see para. 22 below). The reason is that warming the air intake of either a gas turbine or engine will reduce both power and efficiency.

22. There are several potential independent and supplementary uses for low-level heat. Low level heat energy leaving the heat recovery boiler (with conventional boiler in which the gas exits at temperatures approximating 200°C and possibly 110°C reject heat from the lubricating oil cooler) of engine-driven generators could be recovered and utilized during the colder months to warm water for aquaculture, to warm the soil for certain crops or to heat greenhouses if the surrounding area either includes or could be developed to include facilities to utilize this low-level heat.

Heat Distribution and Transfer Systems

23. In many retrofit situations, the heat distribution and transfer systems also provide opportunities for energy savings through the introduction of: (a) very efficient adjustable speed drives for electric motors and conversion of existing constant-flow district heat systems to variable flow, thereby minimizing the pumping energy; (b) automation and control of consumer substation; (c) upgrading and rehabilitation of thermal insulation to reduce heat losses and introducing other modifications to reduce energy-consuming and unnecessary resistance to flow in the distribution system; and (d) reduction of water and heat losses through the repairs of leaks. Depending on the severity of any particular winter season, the condition of the piping insulation and other factors, such measures could reduce consumption of electric power required to pump energy by up to 50 percent and heat losses by 10-20 percent.

End-user Energy-Efficiency and Conservation Measures

24. These measures pertain to apartments, offices, commercial establishments, classrooms, auditoriums, in-door recreation facilities, kitchens and lunchrooms frequently served by district heating systems. They can reduce energy consumption while maintaining or improving the level of service and comfort. Improving the energy-efficiency of the end-uses served by boilers that are candidates for coal-to-gas conversion can further reduce CO_2 emissions. Possible methods for improving end-use energy-efficiency can include: (a) improving the internals of the buildings (such as the heat transfer, distribution and control systems in the buildings); (b) the addition of energy-efficient building equipment (glazing, insulation and the like); (c) the installation of energy-efficient electric appliances; and (d) changing the behavior of the users. While

improvements in the heat distribution and transfer systems and in the end-use facilities are not "coal-to-gas technology" options, such energy-efficiency improvements become an integral part of any systems approach to boiler conversions.

25. Personal initiatives to lessen the waste of energy and low-cost modifications can reduce energy waste by 10 percent. The GEF coal-to-gas conversion project would focus primarily on low-cost easy-to-capture improvements in end-use efficiency, which would produce an estimated reduction in heat demand of about 10 percent. These measures could include the installation of individually controllable thermostats and thermometers in each room, training of building occupants/users in energy conservation, and use of either clear plastic film or insulating drapery fabrics, or both, for window insulation. Perhaps most important, financial responsibility for energy use should be assigned to individual apartment occupants by installing heat energy meters for each apartment building and cost-sharing devices (such as low-cost evaporator meters) in each individual apartment unit so that billing can be based on actual energy consumed. Such occupant/user initiatives combined with low-cost devices to assist in occupant/user energy conservation initiatives are planned for the two GEF pilot projects in Krakow and the follow-on investments to be identified under this project.

26. More costly additional energy-efficiency and conservation measures can result in total energy reductions approximating 30 percent. These added measures include: (a) improvements in the insulation of the building envelope (roof, walls (including windows and doors) and floor); and (b) use of more energy-efficient electrical lighting and appliances. These measures are not included in the plans for individual coal-to-gas conversion projects for existing buildings. By inference from studies in Poland and elsewhere, however, improvements in the efficiency of building equipment, controls and operations can reduce heat demand by 20-30 percent or more on a cost-effective basis from a national perspective. Attaining such large reductions in heat demand as a result of improvements in end-use efficiency is not a primary focus of this coal-to-gas conversion project. However, funding to obtain such large reductions in heat demand for selected projects could be obtained via collaboration with other programs. In this context, the coal-to-gas conversion project can be viewed as part of a larger program of improved energy use, lower energy costs and an overall reduction in CO_2 emissions. To achieve its objectives, the coal-to-gas conversion project complements, but does not substitute for, action under existing programs in Poland.

27. Measures toward energy-efficiency in new residential buildings. Although not part of the coal-to-gas conversion component, improvements in the energy efficiency of new residential buildings also offer an ideal opportunity to influence quickly and strongly future investments to the benefit of global environmental objectives. The aim would be to demonstrate that cost-effective energy-efficiency measures in new residential buildings can produce significant reductions in CO_2 emission in the residential/household sector in Poland by introducing cost-effective energy efficiency measures, where the measures meet standards above the current ones for buildings in Poland.

28. Some of the measures to be considered during the architectural design of new buildings are: (a) alternatives for the envelope systems of the buildings, including insulation and window options, use of large energy-efficient panel construction techniques, thermal breaks, and the latest glazing and framing technologies; (b) alternatives for the internals of buildings, including lighting, heat control/distribution/measurement, and ventilation systems; (c) appliances with differing levels of energy-efficiency (especially refrigerators); (d) alternative construction practices for major buildings; (e) alternative operation and maintenance strategies to increase energy efficiency for major buildings, including structures and procedures for paying bills for electricity, space heating, domestic hot water and service water, as well as innovative ideas for measuring and controlling the consumption of electricity, gas and heat; (f) alternative financing mechanisms through grant or low-interest loans to induce developers or individual owners to undertake energy-efficiency measures in the architectural design of new residential buildings; and (g) alternative repayment mechanisms based on actual energy savings, in the case of loans supporting energy efficiency.

29. It is proposed that the present GEF project would finance energy-efficiency measures in new residential buildings. The GEF financing would also be made on a grant basis. The amount of incremental GEF funding would be determined case-by-case, based on: (a) an energy audit of the initial architectural design and efficiency of the building; and (b) an analysis of the cost effectiveness and environmental impacts of alternative energy-efficiency measures to be included, using typical Polish building construction, operation and maintenance practices and current energy efficiency standards for buildings as the base case.

Environmental Benefits

30. The project would demonstrate how substituting natural gas for coal and utilizing gas-fired high-efficiency boilers and natural gas-fueled engine or gas turbine-powered CHP plants can reduce CO_2 emissions from district heating plants. The advanced technologies demonstrated in the two GEF pilot projects in Krakow would be replicated several times to demonstrate their commercial feasibility and to provide a database on industrial and institutional experience in planning, financing, construction and continuing operation. This database would include information on initial and continuing costs and environmental improvements.

31. In addition, major reductions in the emissions of pollutants of local and regional concern would be achieved. Essentially 100 percent reductions in the emissions of SO_2 and particulates are expected; and depending on the equipment used and on whether a de-NOx system is installed, NOx emissions can be reduced to only a few percentage points of the levels emitted by the coal previously burned.

32. The indirect environmental benefits include reductions in surface disturbances such as subsidence, accumulations of mining and cleaning plant wastes that result from mining, cleaning and transportation of the displaced coal and the disposal of coal ash.

33. Coincidental environmental benefits are also anticipated: The technologies can be used beneficially and efficiently to burn collected methane from municipal refuse landfills, sewage digestors and coal seams. That methane would otherwise escape into the atmosphere. Compared with CO_2 emitted into the atmosphere, methane has about 21 times the global warming potential of CO_2, on a mass basis and over a 100-year time horizon.

Considerations Affecting Choice of Engines or Gas Turbines for CHP Installations

34. Efficiencies. In the expected capacity range of the CHP projects to be supported under the GEF project (about 500 kWe to 2 MWe), the engines are generally somewhat more efficient and can be modestly less costly than gas turbines. When the economic value of electric power is high and provides the financial incentives to generate electric power, small engines are frequently chosen over turbines because of their higher efficiencies.

35. Relative Power and Heat Requirements. Because of their greater efficiency in generating electricity, engine-generator sets generally reject less heat than a gas turbine does. A 1 MWe gas turbine-generator set may reject 2 MWt or more at about 500°C, while an engine of the same capacity may reject 1-1.5 MWt. Exhaust from the engine approximates 500°C, but 30-40 percent of the engine's reject heat is from general engine cooling, generally at about 100-120°C.

36. Flexibility of Power and Heat Ratings. If there are compelling reasons to select an engine rather than a gas turbine, or if there is reason to choose a generator set with electrical capacity that results in a shortfall in the supply of exhaust heat, supplemental boiler firing or additional HOBs can be installed at modest cost to provide more thermal output. Supplemental firing would likely be required in any case to meet peak heating needs and as an emergency heat source in case there is a forced turbine or engine outage during very cold weather.

37. Availability of Spare Parts and Experienced Personnel. Ready availability of spare parts and a pool of trained and experienced operating and maintenance personnel are important considerations in the choice of an engine or turbine.

38. Sensitivities to Air Quality, Fuel Purity and Noise Suppression Requirements. Gas turbines are more sensitive to particulates in the intake air and in the fuel than are engines, but either prime mover will require air and fuel filters. Since small district heating plants are likely to be located in populated areas, intake and exhaust silencers are a likely necessity. A system for reducing the NOx in exhaust gases may be required. Where the pressure of the natural gas supply is low, as in the case in Krakow, a gas compressor that raises the pressure of the supply to the gas turbine would be required. The energy required for gas compression can lower the efficiency of the set by about 2 percent.

39. **Flexibility for Utilizing Reject Heat from Gas Turbine Generator Sets.** Gas turbine generator sets offer additional flexibility for utilizing reject heat. The options include the use of high-temperature heat exchangers (recuperators) to "recycle" the exhaust heat from the turbine back to the combustor to reduce the fuel requirements and increase the efficiency of electrical generation. Alternatively, the exhaust heat can be used to generate steam for injection into the gas turbine to increase the power output by about 15-20 percent. Either option can be employed continuously or intermittently when the exhaust heat is not needed for other purposes. During the warmer months when the supply of electric power is needed and the supply of heat is not needed, some CHP facility operators find it attractive to utilize absorption refrigeration chillers to cool the inlet air to the turbine to improve compressor efficiency and maintain full generator output.

40. **Other Options for Utilizing Reject Heat from Either Engine or Gas Turbine Generator Sets.** Absorption refrigeration chillers that utilize the exhaust heat from either gas turbine or engine generator sets can provide cooling for such applications as hotels, resorts and hospitals. Some space conditioning requirements, such as cooling in summer and heating in winter, could permit beneficial year-round utilization of the reject heat from either gas turbine or engine generator sets.

41. **Costs.** A CHP gas turbine generator or engine-powered generator set with a heat recovery boiler and control station may cost about $1,100-1,600 per kWt (installed), where the electrical generating capacity is in the range of 500 kWe to 2 MWe. The cost differences between turbines and the more reliable slower speed engines are likely to be less significant.

42. **Future Technology Prospects.** Manufacturing and research organizations continue to improve the technologies for engines, boilers, and gas turbines. The field of large-capacity gas turbines has had some of the more dramatic recent developments, including the introduction of higher inlet temperatures, improved reliability, improvements in cycle efficiency and reduction in NOx emissions. Related developments continue in the engine and boiler fields, and technologies that reduce NOx emissions even further appear likely. Hopefully these impressive developments will later be applied to the smaller capacity machines of interest to the GEF project.

POLAND - COAL-TO-GAS CONVERSION PROJECT

Existing boilers, Conditions, Conversion Options and Projected Results

Heat Output for all cases normalized to 1MWt
Electricity production, if any is in addition to heat output

PRESENT STATUS OF EXISTING BOILERS					OPTIONS FOR CONSIDERATION AND EVALUATION /a	EXAMPLES OF NEW STATUS IF IMPLEMENTED									
										CO-2 EMISSIONS REDUCTION kg/hour CO-2			FUEL USE REDUCTION kcal/hour		
FUEL	AGE	CONDITION	REMAINING LIFE (YEARS)	EFFI-CIENCY %		FUEL	CONDITION	REMAINING LIFE (YEARS)	EFFI-CIENCY %	BEFCRE	AFTER	PERCENT	BEFORE	AFTER	PERCENT
Coal	----	----	----	100	Convert from coal to gas (BASE CASE - Impact of type of fuel alone on CO-2 formation)	Gas	----	----	100	317	178	44%	860	860	0%
Coal	Middle	Good	Several	65	Reduce casing air leakage Add high efficiency economizer Burn cleaned low sulfur coal Improve fly ash collectors	Coal	Good	Several	85	488	373	24%	1,324	1,012	24%
Coal	New	Excellent	Many	85	Reduce casing air leakage Add condensing economizer Convert to gas firing	Gas	Excellent	Many	90	373	198	47%	1,012	956	6%
Coal	Old	Poor	Few/none	50	Remove & replace with condensing boiler	Gas	New	Many	95	635	188	70%	1,721	906	47%
Coal	Old	Fair	Few/none	50	Remove & replace with reciprocating engine and heat recovery boiler	Gas (Output - same heat as before plus 590 kWe of electricity)	New	Many	78	810 /b	365	55%	3,259	1,761	46%
Coal	Old	Fair	Few/none	50	Remove & replace with gas turbine and heat recovery boiler	Gas (Output - same heat as before plus 314 kWe of electricity)	New	Many	78	744 /b	313	58%	2,678	1,511	44%

Notes:

/a Actual results of implementing options would depend on specific site conditions and design decisions.

/b Carbon dioxide emissions before modifications include those from conventional coal fired power stations resulting from generating same quantity of electric power as the new facility

POLAND - COAL-TO-GAS CONVERSION PROJECT

Criteria for Eligibility and Selection of Priorities Among Coal-to-Gas Conversion Projects and Energy Efficiency Projects in New Residential Buildings

Introduction

1. This annex provides the Bank Ochrony Srodowiska SA (BOS), the implementing agency, and the Scientific and Technical Advisory Panel (STAP) with a set of criteria for eligibility and priorities for the selection of boiler coal-to-gas conversion projects and energy efficiency projects in new residential buildings. Developed during the appraisal of the pilot projects in Krakow, these criteria should be refined and amended as individual projects develop in order to address continuously the cost-effectiveness of the GEF project activity and ensure its consistency with the global environmental performance objective. STAP would have the mandate to review and amend these criteria, as needed. These criteria supplement the generic criteria developed by the Bank-GEF/STAP in May, 1992.[1/]

Bank-GEF/STAP Criteria for Eligibility and Selection of Priorities

2. The criteria listed in the first three main categories below have been adapted and condensed from the document on selection criteria for GEF projects produced by the Bank-GEF STAP.

3. General GEF Criteria. The following are the general GEF criteria for projects involving emission of greenhouse gases (from GEF Criteria, 4.0, by Bank-GEF STAP, May 1992):

(a) Decision-makers should have available a growing list of technologies offering the greatest emission reductions at the lowest potential cost.

(b) Efforts should be made to promote the general use of the technology in cases where the technology, the economics or the market are not yet "right."

(c) GEF funding should be provided to encourage the inclusion of technologies with global environmental benefits in the decision portfolio.

4. Additional GEF Criteria. The following is an additional GEF criterion for the eligibility of projects relative to reductions in emissions of greenhouse

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1/ "Criteria for Eligibility and Priorities for Selection of Global Environmental Facility Projects," Global Environmental Facility, Scientific and Technical Advisory Panel, Nairobi, May 1992.

gases (from GEF Criteria, 4.1.1, by Bank-GEF STAP, May 1992). This GEF criterion relates to specific emission reduction technologies (ERTs):

(a) Mainstream financing would not otherwise be available in-country and locally as lenders and owners would not consider the technology (such as high-efficiency boiler and cogeneration unit) to be ready for support. GEF funding would be crucial to the implementation of the ERT.

5. GEF Replicability Criteria. To ensure replicability, the project should have (from Bank-GEF Criteria, 4.1.2, by GEF STAP, May 1992):

(a) A well-developed plan for documentation that would result in the preparation of complete implementation packages, including hardware and software (policies, policy instruments, policy agents, institutions, financing, management, and so on).

(b) A well-developed plan for performance evaluation, including specific plans for monitoring the measures taken to reduce greenhouse gases, their effectiveness (monitoring before and after conversion) and their cost-effectiveness.

Specific Eligibility Criteria and Selection of Priorities Among Coal-to-Gas Conversion Projects

6. Eligible Individual Boiler Projects. Boilers eligible for GEF consideration are non-industrial boilers supplying heat, domestic hot water and/or steam to residential and institutional district heating systems. Potential beneficiaries could be public institutions, public and private non-industrial enterprises, such as housing cooperatives, district heating enterprises, and hospitals. Boilers supplying industry premises with steam for industrial processes would not be considered under the present GEF project.

7. Conversion technology considerations. The approved approach for the Poland GEF project is the conversion of coal-fired heating boilers of small and medium-size capacity to natural gas-firing. The technologies used to implement the program must be innovative to qualify. Innovative in this context refers to technologies not as yet introduced to any significant extent in Poland but that are in widespread commercial use in Western countries. The technologies that meet this criterion are: (a) high-efficiency natural gas-fired boilers, of non-condensing and condensing type; and (b) natural gas-fired cogeneration plants utilizing either reciprocating engines or gas turbines and supplying heat and electricity. The normal acceptable heat input should be in the range 1-15 MWt. Ranges below 1 MWt would also be acceptable.

8. Diversity in Technologies to Reduce Emissions of Greenhouse Gases. Diversity is important because of the importance of developing a record of experience with different technologies and a database that can be used to verify which of the energy efficiency and conservation measures have proven the most

practical and cost-effective in Poland for reducing emissions of greenhouse gases. Priority would be given to conversion projects that add to the diversity of energy efficiency and conservation measures believed to be effective technologies for reducing greenhouse gas emissions under the GEF coal-to-gas conversion project.

9. **Internal Rate of Return**. From the point of view of the boiler owner, a conversion project, including energy efficiency improvements (see paras. 14 and 15 below), should be financially attractive. A financial tool for measuring this attractiveness is the boiler owner's required internal rate of return (IRR). The IRR will be calculated on the incremental cash flows between a GEF project case and a reference case (see para. 12). The amount of GEF financing would be determined as the capital subsidy required to bring the rate of return on boiler conversion up to the boiler owner's required IRR. For the first year of the proposed GEF coal-to-gas conversion project, the hurdle rate would be set at 25 percent. As follow-up conversion projects develop, STAP would annually review the appropriateness of this hurdle rate and may propose a change to reflect the changes in conditions in Poland. Any change in the rate would be subject to the prior approval by the Bank and would become effective for the following year.

10. **Amount of the GEF Grant**. The amount of the GEF grant would be equal to the present value of the incremental capital investment costs of the GEF-supported conversion project minus the present value of the savings in operating costs over the project's service life, discounted at the boiler owner's required IRR.

11. **Cost-Effectiveness of a Conversion Technology**. This accounting tool permits a comparison, from the country's point of view, of the economic costs and expected global warming benefits associated with the GEF-supported conversion project (GEF project case), on the one hand, and the costs and emissions of the best conventional alternative that could be implemented without GEF support (reference case), on the other hand. It is defined as the ratio of the annualized GEF capital subsidy to the expected annual quantity of carbon dioxide (CO_2) emissions avoided over the life of the project. It is measured in US dollars per ton of CO_2 emissions reduced. The economic costs include capital investment, operation and maintenance, labor and fuel. Priority conversion project applicants would be determined based on a competitive cost-effectiveness ratio. The lower the ratio is, the higher the priority of the conversion project is. For purposes of calculating the cost-effectiveness ratio, a 12 percent annuity rate shall be used over a project economic life of 17 years.

12. **The Reference Case**. The reference case would depend on: (a) the in-country conditions prevailing at the time the technical and economic analysis is made, especially with respect to energy prices, labor costs and environmental emission charges; (b) the conditions within the project region, especially with respect to local environmental requirements, priorities, and fees and fines for emissions; and (c) site-specific conditions. For existing boilers that are candidates for coal-to-gas conversion, it must be demonstrated that, from the boiler owner's point of view: (a) replacement of the existing heat facility with a new coal-fired boiler is financially more attractive than continuing to operate

the existing facility in the same pre-conversion conditions; and (b) this replacement is less attractive than a gas-fired option. This replacement assumes that the re-engineering of the overall heat supply and transfer systems must take advantage of privately profitable energy efficiency improvements.

13. **Boiler Candidates**. The following criteria would apply to existing boilers that are candidates for conversion:

(a) If the conversion project involves an existing coal-fired boiler, the boiler should have a track record of operations (converting a non-functioning boiler would not reduce CO_2 emissions). Documentation should be provided to demonstrate that the boiler has been in operation over the last three years with at least 1,750 equivalent full-load hours per year.

(b) The boiler unit capacity should not exceed 5 MWt, with a total capacity of 15 MWt per boiler house.

(c) The pre-conversion heat demand, supplied by the boiler that is a candidate for conversion, would be required after the conversion and for the economic life of the converted boiler.

(d) The age of the candidate boiler must exceed 12 years.

(e) There are no reasonable and cost-effective alternatives to replacing the boiler. The option of eliminating the boiler and linking the building facilities served by this boiler to a nearby district heating system should not be present. If a nearby district heating system exists, documentation must be provided as to why linkage to the system is not feasible.

(f) The cost of accessing an adequate and reliable gas supply network must be justified on the basis of project economics and not reduced emissions of greenhouse gases.

14. **Heat Distribution and Transfer Systems**. The following criteria would apply to the heat distribution and transfer systems associated with existing boilers that are candidates for conversion:

(a) The general physical condition should be adequate for the basic system to continue in reliable operation, except for conventional maintenance, for the economic life of the conversion project.

(b) The project proposal must include economically justifiable measures for improved energy efficiency in the heat distribution and transfer systems. Heat distribution and transfer systems requiring major replacement of piping, rebuilding or restoration would not be eligible for GEF funding.

15. <u>User Facilities (Apartment Buildings and/or Institutions)</u>. The following criteria would apply to the user facilities supplied by existing boilers that are candidates for conversion:

(a) The facilities should have an adequate future lifespan to ensure the cost-effectiveness of conversion. The expected useful life of heating demand facilities must be greater than or equal to the life expectancy of the converted boiler (a minimum of 20 years).

(b) The general structural condition must be sound so that the basic system would continue in reliable use over the life of the conversion project without major rehabilitation. User facilities requiring major rehabilitation would not be eligible for GEF funding.

(c) Only cost-effective energy retrofit measures for existing building facilities would be part of the applicable boiler conversion project.

16. **Least-cost Criteria**. A project proposal should cover the conversion of the coal-fired boiler to gas firing and the installation of cost-effective energy efficiency measures in the associated heat distribution and transfer systems and in the end-user facilities served by the boiler. If included in the project, improved energy efficiency in the heat distribution and transfer systems and in end-user facilities could result in a downsizing of the replacement boiler. The cost savings from boiler downsizing may be included in the economic justification of the energy efficiency improvements. Because of a number of constraints affecting boiler sizing and efficiency, only 67 percent of the downsizing shall be used when calculating the economic benefits from the downsizing. To implement only cost-effective energy efficiency measures, the costs of improvements in the heat distribution, transfer and end-user systems shall not exceed 67 percent of the avoided costs of the boiler downsizing.

17. **Eligibility Criteria for New Projects or for Mixed Existing and New Projects**. These criteria would apply to new boilers for which procurement of equipment and installation has not yet started. If the new boiler is planned to use coal as a fuel (reference case), then the conversion to gas-firing technology (GEF project case) would be eligible for GEF financing. If the new boiler is planned to burn natural gas in a conventional boiler technology (reference case), then the conversion to a higher efficiency gas-fired boiler (GEF project case) would be eligible for GEF financing. In both cases, improvements in the heat distribution, transfer and end-user systems (existing and new) should be integrated in the project proposal so to achieve the required IRR.

18. **Eligibility Criteria for Boiler Owner**. The local BOS office should certify the boiler owner's financial, management and operating capabilities based on examination of financial statements, operating records and/or a personal interview.

19. **Environmental Considerations**. The following criteria would apply to the environmental requirements for conversion projects:

(a) They must meet all local and national environmental requirements.

(b) They must yield reductions in emissions of greenhouse gases greater than those that could be achieved by economically justified measures only.

20. **Project-wide Consideration**. The following criteria would apply for all conversion projects:

(a) The local BOS office should certify that the owners, apartment tenants and local government support the project and that responsible opposition is absent.

(b) The project proposal should be prepared for the owner by a licensed engineering firm or a registered individual expert.

(c) The conversion project must be completed within two years. The project implementation period shall begin with the date the owner is notified that STAP has accepted the project proposal.

Specific Eligibility Criteria and Selection of Priorities Among Energy Efficiency Projects in New Residential Buildings

21. **Criteria**. The following criteria would apply to project applicants for the Energy Efficiency Fund (EE Fund). Created under the GEF project this fund would finance energy efficiency projects for new residential buildings:

(a) The EE Fund would finance all measures that increase the energy efficiency of the building above the level required by Polish Housing Energy Efficiency Standards. Measures could include: (i) improving the building's internals such as heat automation and control; (ii) improving the building's externals such as insulation for the foundation, floor, walls, roof, doors and glazing; (iii) energy-efficient electric appliances; and (iv) consumer information on energy conservation awareness and efficient consumption.

(b) Applicants must have secured construction financing.

(c) Housing projects for which construction has already started could still be eligible for the EE Fund if the construction of the walls and the procurement of windows and internal equipment have not yet started. Any construction above the foundations would make the project applicant ineligible for the EE Fund.

(d) The base case energy-efficiency shall meet or exceed applicable current national building energy codes. Ultimately, certification must be provided that the insulation and glazing products have adequate specification and meet the minimum quality requirements for attaining the expected energy savings.

(e) Alternative energy-efficiency cases for insulation of the foundation, floor, walls, roof, doors and glazing and for internal equipment should be examined to meet higher energy-efficiency building standards (similar to current German or Swedish standards) for the building types involved.

(f) An energy audit should be prepared for the owner by a licensed building energy audit firm or individual expert and submitted with the proposal.

(g) Project applicants should agree to follow, as much as possible, the recommendations of the energy audit concerning consumption behavior.

22. **Cost-Effectiveness of the Energy-Efficiency Projects**. The expected energy savings resulting from the increased energy efficiency in the building/housing complex would lead to a reduction in CO_2 emissions at the heat and electricity sources supplying this complex. The cost-effectiveness of the housing energy efficiency project would be calculated by dividing the annualized incremental investment required to increase the energy efficiency of the housing project above current national building energy standards by the expected annual quantity of CO_2 emissions avoided over the service life of the building. For simplicity of calculation, annual operating and maintenance costs for new buildings with and without energy efficiency measures shall be assumed equal. A 50-year service life shall be used for this estimation.

POLAND - COAL-TO-GAS CONVERSION PROJECT

Selection of the First GEF Boiler Pilot Projects

First GEF Pilot Projects

1. Preparation of the first GEF coal-to-gas conversion projects is critical to establish the organizational and technical framework and build up the institutional capability to replicate the GEF coal-to-gas concept throughout Poland. To facilitate GEF project preparation, the city of Krakow was selected for the initial GEF coal-to-gas operation. Its selection was justified because of the availability of a database the Bank could use on small and medium-size coal-fired boilers and on the results of a boiler elimination program carried out under various technical programs. Further, the boiler houses in Krakow represent typical unit sizes and technologies found in other cities in Poland. A discussion of this background follows.

Krakow - Boiler House Survey

2. Krakow is situated in the most polluted region in Poland, the southern region. Most of the pollution in Krakow originates from emission sources with low stacks. These sources, consisting of coal-fired stoves and coal-fired boilers, contribute more than 30 percent of the emissions of sulfur dioxide (SO_2) and a significant part of the emissions of nitrogen oxides (NOx), and are the primary sources of particulates and carbon monoxide (CO). Because of Krakow's poor natural ventilation and temperature inversions, these sources have a major impact on air quality during the winter, especially in the downtown area of the city where access to a district heating network is not yet available.

3. Under a US$20.0 million grant-financed assistance package from the United States Agency for International Development (USAID), the *Voivodship* and the municipality of Krakow are undertaking a program aimed at: (a) improving the air quality in Krakow through the introduction of clean coal technologies; (b) reducing the demand for space heating by improving building thermal efficiency; (c) switching to alternative network fuels (district heat, electricity and natural gas) wherever possible; and (d) installing a flue-gas desulfurization unit in an old power plant, Skawina. This program is known as the Krakow Clean Fossil Fuels and Energy Efficiency Project.

4. As part of this assistance, the Krakow Bureau of City Planning has completed a survey of low-stack emission sources. There are about 130,000 coal stoves (with a total capacity of 394 MWt) and about 1,300 small coal-fired boiler houses (or 2,929 boiler units, with a total capacity of 1,065 MWt) within the city alone. This survey shows that more than 60 percent of the coal stoves and 48 percent of the boiler houses are situated in downtown Krakow.

5. The boiler units that qualify as low-stack emission sources have heat output capacities ranging from a few kilowatt-thermal (50 kWt) to 2,200 kWt, an average for the higher capacity units. The frequency distribution of the boiler unit size is skewed at both extremes of the range of boiler unit sizes considered: (a) toward the 50-500 kWt range, with about 2,640 boilers (550 MWt

total capacity) within this range; and (b) 216 boilers (463 MWt total capacity) with unit sizes above 1.0 MWt (see Figure 5-1 of this annex). Boiler efficiency is about 55-65 percent for the smaller units (below 1.0 MWt) and about 75 percent maximum for the larger ones (above 1.0 MWt).

6. The boiler houses supply more than 35 percent of the heat demand in Krakow, produce about 6,768 Terajoule (TJ) and consume about 10,659 TJ of the fuel used equivalent to about 429,000 tons of coal and coke combined. The average coal used in these boilers contains about 0.8 percent sulfur and 21 percent ash. On average, the boiler houses emit about 6,863 tons of SO_2 and 10,653 tons of particulates annually. About 36 percent of the total carbon dioxide (CO_2) emissions from the boiler houses in the *Voivodship* of Krakow, or 1.19 million tons of CO_2, is emitted annually from downtown Krakow's entire heat-only-boiler (HOB) capacity of 1,065 MWt. Figure 5-2 of this annex presents estimates for the CO_2 emissions for each boiler unit size.

7. The coal-fired boilers can also be categorized on the basis of their firing method. In terms of capacity, almost half the boilers in Krakow are manually fired and use primary coke (with a calorific value of about 6,750 kilocalorie per kilogram (kcal/kg)); the other half are mechanically fired and use high-grade hard coal (with a calorific value of 5,250 kcal/kg). There are about 2,585 hand-fired units (548 MWt total capacity) and 344 mechanically fired units (517 MWt total capacity). The hand-fired boilers produce about 45 percent (3,049 TJ) of the heat energy demand supplied by the boiler houses in Krakow and consume 52 percent (5,544 TJ, equivalent to 197,000 tons) of the fuel used (coke and coal combined). They are responsible for 63 percent of the ash emissions (6,690 tons). The balance of the heat energy demand (about 55 percent or 3,719 TJ) is supplied by the mechanically fired boilers. They consume 48 percent (5,115 TJ, equivalent to 233,000 tons) of the fuel used (coke and coal combined) and are responsible for 54 percent of the SO_2 emissions (3,724 tons) and CO_2 emissions (644,000 tons).

8. As part of the USAID technical assistance (see para. 3), preliminary tests carried out on typical coal-fired boilers and coal stoves, with extrapolation to the whole population of low-stack emission sources, showed that coal stoves contribute as much as coal-fired boilers to the emissions of particulates and a third of the CO and NOx emissions. Mechanical-fired boilers have the largest share of SO_2 and NOx emissions.

9. SO_2, NOx, CO and particulates have adverse effects on health, causing respiratory and heart diseases, bronchitis and cancer. The frequency of these diseases among the population in Krakow is among the highest in Poland. It is therefore urgent that mitigating actions to alleviate the adverse impact of these low-stack emission sources and improve the air quality in Krakow be undertaken.

Strategy for Reducing Environmental Emissions in Krakow

10. Improving the air quality in Krakow can be better achieved by reducing the emissions of SO_2 and particulates through the elimination of local boilers and using cogenerated heat from existing combined heat and power plants in Krakow. From the total 1,065 MWt HOB capacity in downtown Krakow, about 578 MWt (or 54 percent) could be eliminated and connected to the district heating system, 220 MWt (or 21 percent) converted to gas-firing and 100 MWt (or 9 percent) to oil-

firing, and 167 MWt (or 16 percent) retrofitted. All these measures would, inter alia, contribute to reducing CO_2 emissions from Krakow.

Selection of the Pilot Projects and Recommended Conversion Technologies

11. A first screening of 25 boiler houses in Krakow and site inspections were made on the basis of boiler unit size, age, efficiency, accessibility to district heating and gas networks, and potential for replicability. After this first screening, a technical and economic analysis was performed to select the sites for which the highest performance indicator (tons of CO_2 reduced per dollar invested) can be achieved and for which various innovative technology options can be implemented.

12. Two sites were finally selected, each representing a typical boiler unit size found in Poland. For each site, a specific conversion technology was recommended. For the 0.2-0.5 MWt unit size range, conversion to a modern gas-fired condensing boiler was recommended, whereas for the 1.1-2.9 MWt range, an optimum supply mix, consisting of a base-load small gas-fired cogeneration unit together with peak hot water boilers and steam boilers, was developed. A detailed description of the pilot projects is provided in Annex 6.

The Importance of the Pilot Projects for Documentation, Training and Replicability

13. The pilot projects are important vehicles for testing and implementing key project procedures, application forms and training. In this context, the experience of the pilot projects must be carefully tracked, documented and evaluated.

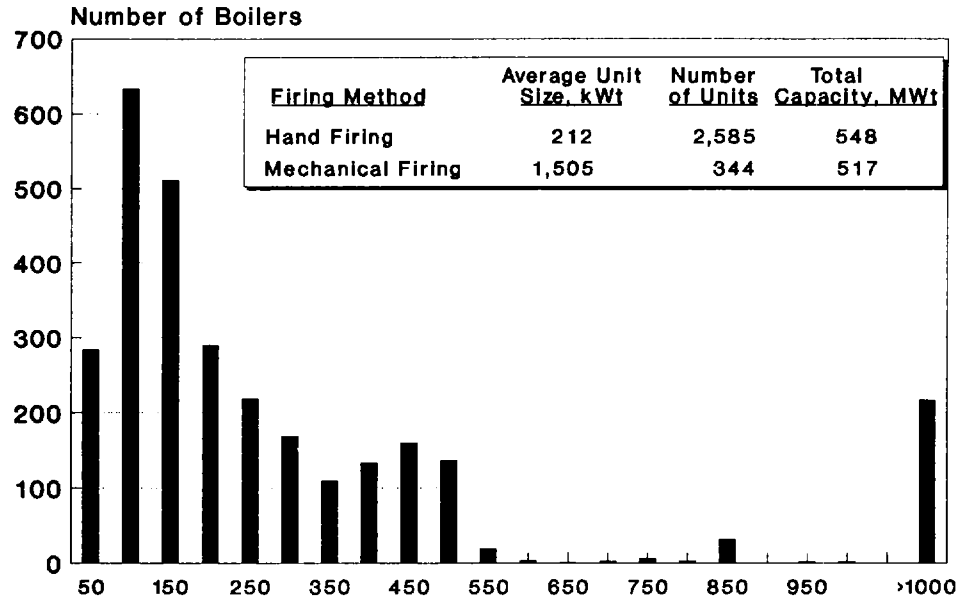
14. **Documentation**. Procedures should be revised, based on experience with the pilot projects. In particular, each problem that surfaces needs to be documented and solutions to each problem built into the procedures and checklists for subsequent projects.

15. **Replicability**. For example, application forms should request information about boiler sizes, loads and fuels used, including sample fuel invoices as feasible. Site visits should confirm sizes, loads and fuels. Problems have already arisen in the pilot projects because of incorrect or incomplete information relative to project applicability. A case in point is that the owners in both the pilot projects indicated the use of coal fuel during the pre-feasibility studies, yet coke was being used. Likewise, information about the size and mix of new residential housing projects has changed substantially upon review. Lessons learned from such problems need to be incorporated into future projects.

16. **Training**. The pilot projects provide opportunities for training key participants in GEF project activities.

17. **Refinements**. Additional technical assistance requirements would be identified during completion of the pilot projects. The above description of activities would be refined as needed as part of the replicability of project activities.

Krakow - Boiler Survey
Distribution of Boiler Unit Size

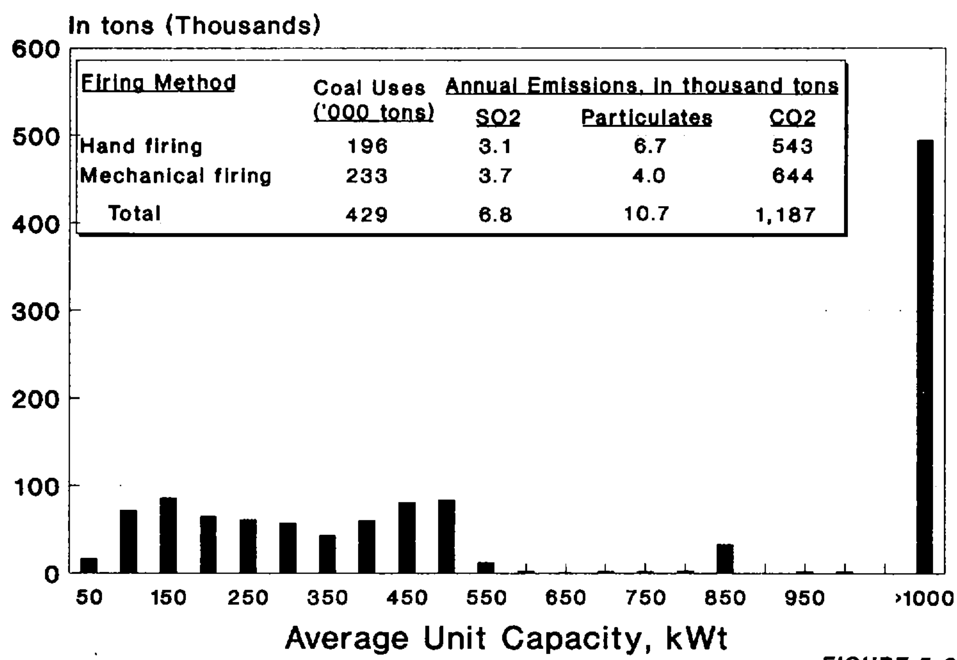


Firing Method	Average Unit Size, kWt	Number of Units	Total Capacity, MWt
Hand Firing	212	2,585	548
Mechanical Firing	1,505	344	517

FIGURE 5-1

Krakow Bureau of City Planning, 1992

Estimates of Carbon Dioxide Emissions
from Boilerhouses in Krakow



Firing Method	Coal Uses ('000 tons)	Annual Emissions, in thousand tons: SO_2	Particulates	CO_2
Hand firing	196	3.1	6.7	543
Mechanical firing	233	3.7	4.0	644
Total	429	6.8	10.7	1,187

FIGURE 5-2

World Bank Estimates, March 1994

POLAND - COAL-TO-GAS CONVERSION PROJECT

Description of the Krakow Pilot Projects

Existing Facilities

1. The two pilot projects, as described below, are located at Jana Street and at Warszawska Street and Heclow Street. In the rest of the annex, the pilot projects are referred to by the name of the street (Jana and Warszawska) on which they are located.

2. Jana Street. The boiler house, located in the old city center of Krakow, belongs to the municipal district heating enterprise of Krakow (MPEC Krakow) and supplies old buildings and the City Office. It comprises 7 coal-fired boiler units of the cast-iron segment type with manual stoking, with sizes ranging from 0.15 to 0.5 MWt and with a total capacity of 2.5 MWt. The boilers are old both in design and age (31 years of service). They are inefficient (50 percent on average), burn about 615 tons of coal annually and contribute to the pollution in the old city center. Carbon dioxide (CO_2) emissions from the boiler house are estimated at about 1,700 tons annually. Peak and energy heat demands were estimated at 1.63 MWt and 2.6 GWh, respectively. At this site, only hot water is produced for heating purposes.

3. Warszawska Street and Heclow Street. The facility consists of two boiler houses located in two geographically separated sites, both in downtown Krakow. The larger boiler house belongs to the Polytechnic University of Krakow (PUK) and the smaller one to the Krakow Senior Citizens Home (KSCH). Together, the two facilities comprise 15 boiler units with a total capacity of 10 MWt. The units have 19 years of service. Four units at PUK are of the traveling grate type (or mechanical firing), with unit sizes ranging from 1.2 to 2.2 MWt. The remaining 11 units are of the cast-iron segment type with manual stoking and have unit sizes ranging from 0.15 to 0.45 MWt. About 3,625 tons of coal are burned annually at both sites combined, with about 8,104 tons of CO_2 emitted annually. Peak and energy heat demands were estimated at 9.1 MWt and 15.7 GWh, respectively. These sites produce both hot water and steam, the latter being used in the cafeteria and laundry facilities.

Conversion Technologies Adopted for the Pilot Projects

4. Energy Supply Side. Qualified foreign and local consultants carried out pre-feasibility studies on both sites. Both the consultants and the boiler owners concluded that the old, inefficient, highly polluting coal-fired boilers in both boiler houses were not suitable for rehabilitation and must be replaced. *At Jana Street*, conversion to modern, high-efficiency gas-fired condensing boilers with a total capacity of 1.5 MWt is recommended. The new facility would comprise three hot water boiler units of 0.5 MWt each. ***At Warszawska Street***, an optimum supply mix, consisting of a small gas-fired cogeneration unit, together

with steam boilers and hot water boilers, was developed. The cogeneration module would be used for base load service during the heating season and would produce 1.3 MWe of electric power and 2.2 MWt of heat. This base load unit would be supplemented by three gas-fired hot water-only peaking boiler units (1.5 MWt each) and two gas-fired steam boiler units of 0.7 MWt each. The total energy supply capacity mix of the new facility at Warszawska Street would have 1.3 MWe for electricity generation, 6.7 MWt for heat production and 1.4 MWt for steam. For the cogeneration module, auxiliary natural gas burners would be installed in the associated heat recovery boilers to permit continued operation of the heating system even if the engine or gas turbine-driven power generator must be removed from service during the heating season or electric power demand from the generator is not required. For both cases, a dual-firing capability was considered to mitigate any risk of temporary shortfalls in gas supply.

5. <u>End-User Side</u>. In both cases, the analysis considered supplementary low-cost but effective end-user energy conservation measures for modernizing the heat transfer facilities and internal building installations before sizing the heat supply sources. Such measures would be part of the project scope and would include insulation of the network distribution and building piping systems, installation of automation and control equipment at the heat transfer substations, installation of thermostatic control valves and heat metering, and increased energy conservation awareness among building users and occupants. These measures would lead to a reduction in both peak and energy demands of about 10 percent at Jana Street and 18 percent at Warszawska Street. However, other conservation measures such as weatherization (wall insulation, window glazing and the like) were not included, and their cost-effectiveness not assessed, as detailed building data and analysis are required. Since these measures cannot be ruled out in the future, a cost-effectiveness analysis was done. It showed that the share of the cogenerated heat must be kept low and that the trade-off is in favor of adding an extra boiler rather than oversizing the cogeneration unit.

6. The reason for selecting two adjacent sites (about 500 meters apart from each other) for the second pilot project was the necessity of bringing the heat demand to a level that could economically justify the installation of the small cogeneration module. The planned new facility would displace the existing coal-fired boiler houses at the two locations and would supply heat and steam to both PUK and KSCH. In addition, the university has obvious potential for replicability of the GEF project concept in a practical, technical framework and for wide dissemination of innovative, efficient technologies for reducing greenhouse gases.

7. <u>Data on the Pilot Projects and Emission Reduction Technology Options</u>. <u>Table 6-1</u> of this annex shows the energy/capacity supply and demand balances before and after including the energy conservation measures, various conversion technology options and the selected option for each site. <u>Tables 6-2</u> (for Jana Street) and <u>Table 6-3</u> (for Warszawska Street) present, for the various technology options: (a) the energy generation and fuel required; and (b) the net abatement of CO_2, sulfur dioxide, nitrogen oxides and particulate emissions.

POLAND - COAL-TO-GAS CONVERSION PROJECT

Data on Krakow Pilot Project

DESCRIPTION OF EXISTING BOILER FACILITIES

	FACILITY I	FACILITY II
Boiler Unit Size Range (kWt)	150 - 500	150 - 2,200
Total Capacity of Existing Boilers (kWt)	2,516	9,994
Number of Boiler Units	7	15
Average Boiler Efficiency	50%	64%
Average Age of Existing Boilers (years)	31	19
Coal Used (tons/year)	613	3,625
CO_2 emission (tons/year)	1,693	8,104

ENERGY DEMAND/SUPPLY BALANCE

	FACILITY I			FACILITY II		
	Before Conservation	After Conservation	Savings	Before Conservation	After Conservation	Savings
A. DEMAND SIDE						
Hot Water						
- Energy Demand (MWh)	2,556	2,300	10%	12,830	10,521	18%
- Peak Capacity Demand (kWt)	1,630	1,467	10%	7,010	5,748	18%
Steam						
- Energy Demand (MWh)				2,829	2,263	20%
- Peak Capacity Demand (kWt)				2,050	1,640	20%
Total						
- Energy Demand (MWh)	*2,556*	*2,300*	*10%*	*15,659*	*12,784*	*18%*
- Peak Capacity Demand (kWt)	*1,630*	*1,467*	*10%*	*9,060*	*7,388*	*18%*
B. SUPPLY SIDE						
Boiler Capacity Required (kWt)		*1,500*			*8,100*	

CONVERSION TECHNOLOGY OPTIONS

	Efficiency
New Coal-Fired Heat Only Boilers	78%
Gas-Fired Heat Only Boilers	84%
Gas-Fired Condensing Boilers	95%
Gas-Fired Cogeneration System	78%

SELECTION OF CONVERSION TECHNOLOGY

A. FACILITY I

High-Efficiency Gas-Fired Condensing Boilers — *3 units, 500 kWt each or 1,500 kWt total*

B. FACILITY II	Hot Water (kWt)	Steam (kWt)	Electricity (kWe)
B.1 One Gas-Fired Cogeneration Unit (Baseload)	2,200		1,300
B.2 Gas-Fired Peaking Boilers (3 units, 1,500 kWt each)	4,500		
B.3 Gas-Fired Steam Boilers (2 units, 700 kWt each)		1,400	
Sub-total - Facility II	*6,700*	*1,400*	*1,300*

Note: *Facility I* is located at Jana Street and belongs to district heating enterprise of Krakow.
Facility II is located at Warszawska Street and belongs to the Polytechnic University of Krakow.

POLAND - COAL-TO-GAS CONVERSION PROJECT

Emission Reduction Options
Facility One - Jana Street

GENERATION AND FUEL DEMAND							
CONVERSION TECHNOLOGY OPTIONS	Thermal Capacity (kWt)	Load Factor hours/yr	Heat Produced (MWh/yr)	Fuel Used (MWh/yr)	Coal (tons/yr)	Natural Gas (000m3/yr)	Light Oil (tons/yr)
Existing Coal-Fired Boilers	2,516	1,016	2,556	5,112	613		
New Coal-Fired Boilers	1,500	1,533	2,300	2,949	354		
New Gas-Fired Boilers	1,500	1,533	2,300	2,738		259	24
Gas-Fired Condensing Boilers	1,500	1,533	2,300	2,421		229	21

Note: All gas-fired boilers will have dual firing capability: gas:90%; light oil:10%.

NET ABATMENT OF THE CONVERSION						
CONVERSION TECHNOLOGY OPTIONS	CO2 EMISSION			SO2 EMISSION		
	Quantity	Reduction		Quantity	Reduction	
	(tons/yr)	(tons/yr)	(in %)	(tons/yr)	(tons/yr)	(in %)
Existing Coal-Fired Boilers	1,693			3.9		
New Coal-Fired Boilers	977	(716)	-42%	2.3	(1.7)	-42%
New Gas-Fired Boilers	546	(1,147)	-68%	0.5	(3.4)	-88%
Gas-Fired Condensing Boilers	483	(1,210)	-71%	0.4	(3.5)	-89%
CONVERSION TECHNOLOGY OPTIONS	NOx EMISSION			PARTICULATES EMISSION		
	Quantity	Reduction		Quantity	Reduction	
	(tons/yr)	(tons/yr)	(in %)	(tons/yr)	(tons/yr)	(in %)
Existing Coal-Fired Boilers	1.1			12.1		
New Coal-Fired Boilers	1.0	(0.1)	-10%	7.0	(5.1)	-42%
New Gas-Fired Boilers	0.2	(0.9)	-81%	0.0	(12.1)	-100%
Gas-Fired Condensing Boilers	0.2	(0.9)	-81%	0.0	(12.1)	-100%

POLAND - COAL-TO-GAS CONVERSION PROJECT

Emission Reduction Options
Facility Two - Warszawska Street

GENERATION AND FUEL DEMAND

CONVERSION TECHNOLOGY OPTIONS	Operating Capacity Thermal (kWt)	Operating Capacity Electric (kWe)	Load Factor (hours/yr)	Heat Produced (MWh/yr)	Electricity Produced (MWh/yr)	Fuel Used (MWh/yr)	Coal (tons/yr)	Natural Gas 000m3/yr	Light Oil (tons/yr)
Existing Coal-Fired Boilers	9,994		1,567	15,659		24,467	3,625		
New Coal-Fired Boilers	8,100		1,578	12,784		16,390	2,428		
New Gas-Fired Boilers	8,100		1,578	12,784		15,219		1,438	134
Gas-Fired Condensing Boilers	8,100		1,578	12,784		13,457		1,271	118
Cogeneration						23,155		2,187	203
- Combined Heat & Power unit	2,200	1,300	4,231	9,308	5,500	19,017			
- Peak Heat-only-boilers (hot water)	4,000		303	1,213		1,444			
- Steam Boilers	1,200		1,886	2,263		2,694			

Note: All gas-fired boilers will have dual firing capability: gas:90%; light oil:10%.

CO2 EMISSION REDUCTION WITH COGENERATION TECHNOLOGY

SEPARATE GENERATION VERSUS COGENERATION	Heat Produce (MWh/yr)	Electricity Produced (MWh/yr)	Average Efficiency	Fuel Used (MWh/yr)	CO2 Emission Quantity (tons/yr)	CO2 Emission Reduction (tons/yr)	CO2 Emission Reduction (in %)
A. Separate Generation in Existing Facilities							
- Coal-fired Heat-only-boilers	15,659		64%	24,467	8,104		
- Coal-fired Power Plants		5,500	34%	16,177	5,358		
Sub-total	15,659	5,500	52%	40,645	13,461		
B. GEF Conversion Project - Cogeneration System	12,784	5,500	79%	23,155	4,618	(8,843)	-66%

NET ABATMENT FOR SO2, NOx AND PARTICULATES EMISSIONS FOR COGENERATION TECHNOLOGY

SEPARATE GENERATION VERSUS COGENERATION	SO2 EMISSION Quantity (tons/yr)	SO2 Reduction (tons/yr)	SO2 Reduction (in %)	NOx EMISSION Quantity (tons/yr)	NOx Reduction (tons/yr)	NOx Reduction (in %)	PARTICULATES EMISSIO Quantity (tons/yr)	Particulates Reduction (tons/yr)	Particulates Reduction (in %)
A. Separate Generation in Existing Facilities									
- Coal-fired Heat-only-boilers - Local Benefits	46.4			6.6			39.9		
- Coal-fired Power Plants - National Benefits	72.1			5.8			26.4		
Sub-total	118.5			12.4			66.3		
B. GEF Conversion Project - Cogeneration System	4.1	(114.4)	-97%	3.8	(8.6)	-69%	0	(66.3)	-100%

NET ABATMENT FOR OTHER CONVERSION TECHNOLOGY

CONVERSION TECHNOLOGY OPTIONS	CO2 EMISSION Quantity (tons/yr)	CO2 Reduction (tons/yr)	CO2 Reduction (in %)	SO2 EMISSION Quantity (tons/yr)	SO2 Reduction (tons/yr)	SO2 Reduction (in %)
Existing Coal-Fired Boilers	8,104			46.4		
New Coal-Fired Boilers	5,428	(2,675)	-33%	31.1	(15.3)	-33%
New Gas-Fired Boilers	3,035	(5,068)	-63%	2.7	(43.7)	-94%
Gas-Fired Condensing Boilers	2,684	(5,420)	-67%	2.4	(44.0)	-95%
CONVERSION TECHNOLOGY OPTIONS	**NOx EMISSION Quantity (tons/yr)**	**NOx Reduction (tons/yr)**	**NOx Reduction (in %)**	**PARTICULATES EMISSION Quantity (tons/yr)**	**Particulates Reduction (tons/yr)**	**Particulates Reduction (in %)**
Existing Coal-Fired Boilers	6.6			39.9		
New Coal-Fired Boilers	5.4	(1.2)	-18%	19.4	(20.4)	-51%
New Gas-Fired Boilers	1.2	(5.4)	-83%	0.0	(39.9)	-100%
Gas-Fired Condensing Boilers	1.2	(5.4)	-83%	0.0	(39.9)	-100%

POLAND - COAL-TO-GAS CONVERSION PROJECT

Project Organizational Structure and Institutional Replicability

Introduction

1. This annex describes several components that together would establish the national and local organizational framework which to permit not only the first pilot projects to be accomplished but also similar conversion projects to be replicated in the future using the structure and resources established. In the proposed framework, the roles and responsibilities for each participating institution, including the communications procedure, would be defined. In addition, local personnel who gained experience under the pilot projects would be able to function as trainers and facilitators to assist in replicating the process in other regions in Poland.

Replicable Project Organizational Structure

2. The overall project organizational structure for the fully implemented GEF project is presented in Figure 7-1 of this annex. This figure shows a two-level structure for purposes of replicability: (a) a national-level GEF project organization structure in Warsaw under a government agency, the Ministry of Environmental Protection, Natural Resources and Forestry (MoE), and a project implementing agency, Bank Ochrony Srodowiska SA (BOS); and (b) a local-level, project-oriented organization structure coordinated by a BOS branch.

The National Level

3. **Ministry of Environmental Protection, Natural Resources and Forestry (MoE).** The role of MoE is to coordinate and supervise, in liaison with the Bank, all project activities, including those of the implementing agency, BOS. MoE would be responsible for monitoring and reviewing project activities and products to assure that they are accomplished with high quality and in a cost-effective and timely manner. On policy matters, MoE would seek a national perspective by obtaining input from representatives of key ministries.

4. **Bank Ochrony Srodowiska SA (BOS) - Warsaw Office.** As implementing agency, BOS would have multiple roles and responsibilities. BOS would administer project activities and related project funds and coordinate the activities of its central and regional offices to accomplish these activities properly. During the project set-up phases, BOS would be responsible for assuring that: (a) the pilot projects are accomplished in timely manner through via proper project implementation management, administration, procurement and disbursement activities; (b) an experienced project engineer is selected to be a representative of the boiler owners for the pilot projects in Krakow; (c) the collateral funding for the pilot projects is secured; (d) standardized procedures and forms for follow-on projects are developed and refined; (e) a marketing plan is developed and implemented; and

(f) technical assistance in selected areas of project preparation, implementation and monitoring are organized for national and regional BOS staffs as well as for other key institutions and individuals within the GEF project organizational structure.

5. While as implementing agency BOS would have overall responsibility for assuring that the above tasks are accomplished, it would receive assistance from foreign and Polish consultants to supplement its in-house staff to accomplish these tasks in the most effective manner. The Polish consultants may be hired at the national and local levels as appropriate. BOS might delegate to such consultants the accomplishment of specific project functions or tasks but is itself responsible for the successful completion of the work.

6. BOS has already designated a project director to head its national and local GEF coordination offices. Assisted with adequate staff, the director would have the responsibility and authority to accomplish properly BOS project-related tasks, to administer its project responsibilities and to serve as the designated liaison with other participating institutions in the project organization. As individual projects develop, national and local offices would be adequately staffed and equipped with modern telecommunications facilities and computers.

7. Throughout the duration of the project, once project set-up is completed, BOS would: (a) administer all project activities, including preparation, appraisal, implementation, monitoring and reporting of project performance results; (b) coordinate procurement activities and supervise bidding procedures in accordance with the Bank Procurement Guidelines for Goods, Works and Services; (c) supervise contracts of all project participants, including local and foreign experts, technical advisors, consultants, contractors and suppliers; (d) coordinate the disbursement of GEF funds and channel them to prospective beneficiaries through monitorable accounts designated for this purpose only; (e) assure the planned marketing activities are accomplished and provide for wider dissemination of the GEF project concept using its network of branches; (f) process and evaluate applications, looking at the cost-effectiveness of candidate projects; (g) coordinate with state and local authorities on policy matters; (h) negotiate funding packages for each individual coal-to-gas conversion projects selected; and (i) administer the energy efficiency component of this project with the assistance of qualified building energy auditors. BOS would not be responsible for negotiating the funding packages for individual project applicants under the energy efficiency component.

8. Systems and procedures would be set up to ensure effective monitoring of the project implementation by MoE and the Bank. BOS would furnish to MoE and the Bank semiannual progress reports on the status of the project, supplemented by a project completion report to be submitted within six months after the project closing date. BOS would also furnish a project completion report for each individual project eighteen months after the acceptance of the individual project by the owner. BOS may utilize consultants to assist it in the preparation of these reports.

9. To cover its cost for administering the GEF project, BOS would receive a

management fee equivalent to 2.5 percent of the GEF grant contribution for the investment component of the project. The management fee would consist of start-up costs for the first year of the project plus a performance-based management fee. The latter would be a function of BOS' ability to perform the list of activities necessary to implement this project successfully, would be calculated as 2.3 percent of the committed GEF grants for individual investment projects and would be disbursed in accordance with individual project milestones (see Annex 17).

10. **Scientific and Technical Advisory Panel (STAP).** STAP's major roles are to review project applicants for GEF funding and to ensure that all GEF projects are designed and accomplished in a technically sound manner. In this role, STAP would function as the technical advisor and partner to BOS in accomplishing project activities. STAP would consist of five scientists (two international --a gas cogeneration specialist and an energy economist -- and three from Poland, including an energy audit/end-user energy efficiency specialist, a district heat specialist and an instrumentation and monitoring specialist). These advisors should be independent, without affiliation to the institutions involved (or that could be involved) in the decision-making of follow-up GEF projects yet to be identified. The Bank would review the qualifications and experience of the members of this panel. During the project preparation phase, the panel would assist BOS in reviewing the second tranche of pilot projects and in refining, inter alia, the detailed rules and procedures for the early steps in the project development cycle.

11. MoE would designate a STAP chairman and secretary. The chairman would be responsible for the coordination of STAP activities and liaison with MoE, BOS and the local technical advisors or local Technical Advisory Groups (TAGs) (see para. 34 below). The secretary would be responsible for documenting STAP actions and decisions. The STAP chairman may also delegate the liaison functions to the STAP secretary as appropriate.

12. STAP would meet routinely, two to three times a year or as required, to provide an independent technical review of all candidate projects to ensure the project designs comply with the GEF scientific and technical requirements (see Annex 4), and, in conjunction with BOS, to assess the cost-effectiveness of these candidates. STAP would determine if the design of each identified project met the stated GEF requirements and would inform BOS (and MoE) of its decisions. STAP may meet at other times as required to accomplish its assigned responsibilities properly. A quorum for STAP meetings would be three or more members, with at least one international STAP member present. All STAP decisions to approve projects to receive GEF grant assistance shall be by unanimous vote. STAP's decision on project approval would be final.

13. No formal meeting of STAP members would be required for STAP's review and approval of project applicants under the energy efficiency component. These projects would be approved on a 'no-objection' basis obtained from three STAP members consisting of one Polish expert, one foreign expert and the STAP chairman.

14. For projects at the appraisal stage, the STAP would: (a) develop terms of reference (TORs) for the services of the TAG members or technical advisors to assist BOS in the appraisal of individual coal-to-gas candidate projects for GEF funding; (b) review the selection process and approve GEF funds for TAG services; (c) review TAG members' products; and (d) approve GEF funding for project implementation. For projects at the implementation stage, STAP would: (a) develop TORs for the services of the project engineers acting as the boiler owners' representatives; (b) review the selection process and approve GEF funds for the boiler owners' representatives; and (c) designate a STAP member to oversee project implementation from the conceptual phase to full operation, including monitoring of project performance. Depending on the size of a project, STAP may delegate the responsibility for oversight of project implementation to a member of the local TAG (see para. 34). Depending on the geographical location of individual conversion projects and their size, STAP could develop TORs to cover consulting services for a group of individual projects.

15. STAP may also assist BOS in defining the technical requirements for other project activities. Besides its technical review activity and upon request, STAP would provide technical assistance to the local experts and TAG members. The local experts would assist the boiler owners in the preparation activities necessary to apply for GEF funding under the project; and the TAG members would assist BOS in project appraisal activities. In addition, STAP would set up a national network for the dissemination and exchange of information among all local technical advisors, building on existing information channels.

16. STAP would implement other information programs such as newsletters, seminars, and presentations at meetings of technical societies to ensure widespread dissemination of STAP activities to the relevant Polish technical communities, so as to facilitate project replicability throughout Poland. Members of the technical community might include representatives from universities, professional architecture and engineering societies, codes and standards organizations, related institutions, foundations and affected industries (for example, boiler suppliers, monitoring equipment suppliers and insulation manufacturers).

17. Expenses related to travel, subsistence and honoraria for both Polish and external STAP members would be supported from GEF project resources to ensure an independent technical perspective.

18. **State Inspectorate for Environmental Protection (SIEP).** SIEP is a state agency whose regulatory functions aim at, inter alia, enforcing air quality standards to control air pollution. SIEP is responsible for: (a) the organization and coordination of the state environmental monitoring systems; (b) the supervision of the compliance with the environmental requirements established by legal and administrative decisions; (c) the enforcement of fees for the use of the environment; (d) the enforcement of fines for non-compliance with environmental requirements; and (e) the issuance of decisions for stopping activities causing damages to the environment.

19. To accomplish its responsibilities, SIEP has a network of regional agencies, the *Voivodship* Inspectorates. The Air Quality Management Component of the Poland - Environment Management Project (Loan 3190-POL) provides, inter alia, a technical assistance, training and monitoring equipment to the *Voivodship* Inspectorates. This assistance aims at: (a) improving the local technical and analytical capabilities to monitor and manage the ambient air quality on a regional scale and in real time, including facility-specific analyses of cost-effective means to reduce air pollution through management and investment; and (b) developing the technical infrastructure to perform consistent and reliable emission inventories, testing and engineering evaluations for air pollution sources in the region. In the Poland - Country Strategy and Implementation Review of October 30, 1992, the Bank recommended that the environmental related services of the *Voivodship* Inspectorates be decentralized and allowed to operate on a semi-commercial basis as means to increase their efficiency in activities for the benefit of the environment at the request of state and local authorities, institutions, organizations and other public and private enterprises.

20. With respect to the GEF project, SIEP's major role would be to assist MoE in: (a) ensuring that the environmental monitoring program under the project is implemented in accordance with established international monitoring and project evaluation procedures, protocols and requirements; and (b) evaluating the results of the environmental monitoring for individual coal-to-gas conversion projects (see Annex 11). In this role, SIEP would function as a technical advisor to MoE in supervising all environmental monitoring activities under the project.

21. **Sources of Collateral Funding.** While the above-described institutions have mainly a technical/administrative role, the sources of collateral funding have specific financial roles and responsibilities. For each GEF individual project, a number of sources of collateral funding exist: (a) the several sources of environmental funds with a national perspective, which will make funds available at preferential rates; (b) commercial banks, including BOS, at commercial rates; and (c) owner equity contributions.

22. Each of the sources of environmental funds with a national perspective and preferential rates has its own set of conditions for financing. A brief description of these sources, including the main terms and conditions for their loans, follows:

23. **National Fund for Environmental Protection and Water Management (the National Fund).** Established in 1989 by MoE, the National Fund operates under: (i) the acts on environmental protection and formation, the water law and the geological law; (ii) the decree on mining law; and (iii) its own statute, conferred by MoE on June 30, 1989. Its objective is to provide financial support to all activities related to the protection of air and earth surface, water management, environmental monitoring and ecological education. The National Fund's income derives from: (i) environmental fees and fines; (ii) licensing fees for the exploration of natural resources; (iii) its own equity capital; (iv) interests on loans granted for ecological purposes; and (v) voluntary remittances from industrial works. The current funding level is about US$400 million per

year. The funds acquired are generally partitioned as follows: 40 percent goes to the national level and 60 percent remains at the *voivodship* level (with about 10 percent allocated to communes and municipalities). There are exceptions to this partitioning. For charges for both nitrogen oxides (NOx) emissions and saline water from coal mining, 100 percent of the funds go to the national level. The allocation process results in great disparities in the funds available for environmental projects across the *voivodships*, but in general the *voivodships* that get the most funds also have the greatest needs. Previously, the *voivodships* could use their environmental money only to subsidize projects. Recently, a new amendment permits the *voivodship* funds to act as legal entities that can give credits, buy shares, etc. The National Fund sees a large requirement for training at the *voivodship* level.

24. Currently, about 48 percent and 32 percent of the National Fund expenditures are for water management and air protection, respectively. Most of the funds are allocated on the basis of loans made at preferential rates, with the remaining funds (focusing mainly on ecological education, monitoring and the protection of nature protection) on a grant basis. The preferential rates for interest-bearing loans are determined as 0.2-1.0 times the National Bank of Poland refinancing rate (35 percent as of April 1994). The multiplying factor depends on both the borrower and the project scope but is generally as follows: (i) 0.2-0.4 for municipal development projects, carried out by state and local authorities; (ii) 0.4-0.6 for loans aimed at the manufacturing of machines and equipment for ecological purposes; and (iii) 0.6-1.0 for the remaining environmental projects. The amount of project financing can be up to 50 percent of the project costs for projects with high environmental priority. The repayment period is generally up to four years, including a maximum of one and a half year grace period. The terms and conditions of each loan are determined and negotiated case-by-case by the Board of Management of the National Fund.

25. **Bank Ochrony Srodowiska SA (BOS)**: BOS SA was established in early 1991 by the National Fund, which is the major equity shareholder with 44.4 percent of BOS shares. BOS operational objective is similar to that of the National Fund. BOS can extend loans at commercial as well as preferential rates. As of April 1994, the terms and conditions for commercial loans were as follows: (i) for short-term loans (up to three months) the interest rate ranged from 37 percent to 40 percent, depending of the project's priority and the borrower's credit-worthiness; (ii) up to one year, the interest rate was 40 percent; and (iii) above one year (maximum three to four years for environmental projects), the interest rate was 50 percent. BOS can also extend preferential loans for environmental projects on roughly the same basis as the National Fund, but with the following differences: (i) the maximum amount of financing per loan is US$1.7 million, equivalent to 10 percent of BOS equity capital, and with a ceiling of 15 percent of BOS equity capital per borrower; and (ii) the borrower must provide an equity contribution ranging from 15 percent to 30 percent of project funds. The difference between commercial rate loans and preferential rate loans is covered by subsidies from the National Fund, which sets up the lending conditions and, jointly with BOS, decides on the terms and conditions for individual projects applicant for preferential loans.

26. **The Polish Debt-for-Environment Swap (EcoFund):** EcoFund was established in 1992 by the Ministry of Finance as an independent foundation to manage funds from the debt-for-environment swap. It emphasizes projects with combined Polish and international impact. EcoFund's priority areas overlap with those of the GEF and comprise: (i) reduction of the long range transboundary air pollution; (ii) reduction of the pollution in the Baltic Sea; (iii) lowering of emissions of greenhouse gases (carbon dioxide (CO_2) and methane) and phasing out of ozone-depleting substances; and (iv) protection of Poland's biological diversity. Similarly, the criteria for project eligibility for EcoFund financing overlap with those of the GEF. Financing from EcoFund is made on a grant basis, with an upper limit of 30 percent of project investment costs. EcoFund co-finances with the National Fund, BOS, commercial banks, etc. Given the similarity between the funds from the GEF and EcoFund relative to project eligibility and financing terms, funds from the EcoFund would be used either to cofinance the grant portion of the GEF individual projects or to extend GEF-type assistance to other individual projects, so that the GEF coal-to-gas conversion concept can be disseminated more widely. This would ensure that the two sources of grant financing are complementary.

The Local Level

27. **Local Involvement for Sustainability and Replicability.** Two major GEF objectives are the sustainability and replicability of its projects. An important means of ensuring these objectives are met under this boiler conversion project is to delegate as much of the decision-making as possible to the regional and local levels. This delegation can include project identification, economic / financial / technical appraisal, project implementation and administration, monitoring and evaluation. Typically, key decisions about small to medium-size boilers are not made primarily at a national level but rather at the local or regional level. Thus, local and regional financial and technical capabilities must be developed to permit a sustainable future stream of coal-to-gas boiler conversion projects. The transfer of local and regional capabilities to other locales is viewed as an excellent means of promoting replicability.

28. **Need for flexibility.** The organizational structure proposed here stresses local decision-making, with subsequent review at the national level. A risk of this approach is the creation of excessive and expensive bureaucratic overhead. To avoid this, informal local structures could be used initially, and formal local structures created in a region only when a clear need exists.

29. **Local BOS Office.** This office would be in charge of administering project-related activities for individual projects within a specified region and ensuring that BOS roles and responsibilities are fulfilled at the regional level. This responsibility includes establishing: (a) proper management and communication procedures between the GEF unit at the local BOS office and the GEF unit at the Warsaw BOS office on matters related to project implementation, procurement and disbursement; and (b) project monitoring criteria and procedures, as well as contracting and payment mechanisms.

30. The national BOS office may wish to establish minimum criteria to be met before a BOS local project office would be established. This criteria might include, for example, a minimum number of existing or anticipated applications from the region and/or a minimum number of awarded GEF grants for projects in the region.

31. During the initial phase of the project, the pilot projects in Krakow would serve as a model for building up the local GEF project and financial management capability within the local branch office of BOS. It is anticipated that BOS regional office in Krakow would administer all GEF projects in the Krakow region. This regional office would be responsible for:

(a) Actively encouraging other boiler owners in the region to undertake coal-to-gas conversion projects by marketing the GEF coal-to-gas conversion concept, providing technical assistance to interested owners of boilers and heating systems, and providing boiler owners of potential candidate projects with a standardized and simplified data and information form to be submitted with each request for GEF supplemental funding assistance; and

(b) Evaluating and recommending the most effective candidates for participation in the GEF nationwide funding program to follow the two pilot projects in Krakow.

32. **Local Policy Advisory Panel.** For key regions, it is anticipated that Local Policy Advisory Panels (LPAPs) would be formed to assure proper policy input from the local level into the GEF coal-to-gas conversion program and to facilitate accommodation of program activities with local priorities. A LPAP panel would consist of representatives of public bodies such as the *voivodships*, the municipalities, the newly created environmental fund organizations within the *voivodships*, and other public entities (for example, representatives of electricity, gas and district heating distribution companies). The main functions of the LPAP panels would be to:

(a) Provide local policy oversight for GEF coal-to-gas conversion projects in the region in order to represent the public interest, consistent with regional and municipal energy and urban planning and local environmental priorities; and

(b) Provide local liaison and communication with the relevant national governmental organizations.

33. **Voivodship Inspectorate for Environmental Protection (VIEP).** Each VIEP would liaise with SIEP on matters related to the supervision of the monitoring activities of all GEF projects implemented within the *voivodship* boundary.

34. **Local Technical Advisors and Technical Advisory Group (TAG).** Providing independent local technical review, evaluation and advice is an important function. Key technical advisory functions include:

(a) Assistance to the local BOSs in technical evaluation, including site inspection, of applications for GEF grants to permit pre-qualification (see step 4 in Figure 9-1 in Annex 9);

(b) Provision of independent technical input, oversight, review and advice to all project activities and decisions in the region;

(c) Provision of ongoing technical assistance and training to encourage and facilitate replication of project activities to other projects and regions;

(d) Technical liaison with the national STAP as well as related technical advisors and groups in other regions of the country; and

(e) Assistance in identifying and facilitating local production and distribution capabilities for high-efficiency boilers, small cogeneration systems and energy conservation technologies.

35. The identification and use of local technical advisors are high project priorities in achieving the sustainability and replicability objectives. Local experts should be identified and utilized as needed on a consulting basis. The national BOS office and national STAP may wish to establish minimum criteria to be met before a formal local TAG is established. The national STAP would approve the selection of the members of the formal local TAG and of a list of local advisory experts (if a formal TAG is not yet established). The national STAP would develop standard TORs and recruitment procedures for the work to be done by the local TAG or local advisory experts.

36. In addition to its core functions, a TAG may accomplish other activities, depending upon the type of GEF projects identified and the specific needs of those projects. Supplemental TAG functions might include: (a) identifying, commissioning, carrying out and monitoring special studies (such as progress reports and completion reports) and analyses related to specific GEF projects; and (b) for GEF projects including housing, examining the possibilities for upgrading current energy conservation codes and standards to economically optimal levels from the regional and national perspectives.

37. Since most GEF projects would include heat supply to buildings, local technical expertise in end-use energy-efficiency technologies should include applications with respect to energy-efficiency design, construction and retrofit of buildings. For GEF projects including housing, expertise might be sought related to energy codes and standards for buildings. Local experts might be sought from the following local groups: housing cooperatives; banks; other potential private investor groups; contractors and developers; architects; engineers; university professors in related technical areas; electric, gas and district heating entities; construction-related financial entities; equipment and material suppliers; codes and standards development and implementation groups. The TAG expertise should permit adequate and balanced involvement of the relevant technical perspectives. Local experts used for advice about project selection or decisions should not be affiliated with the organizations participating in

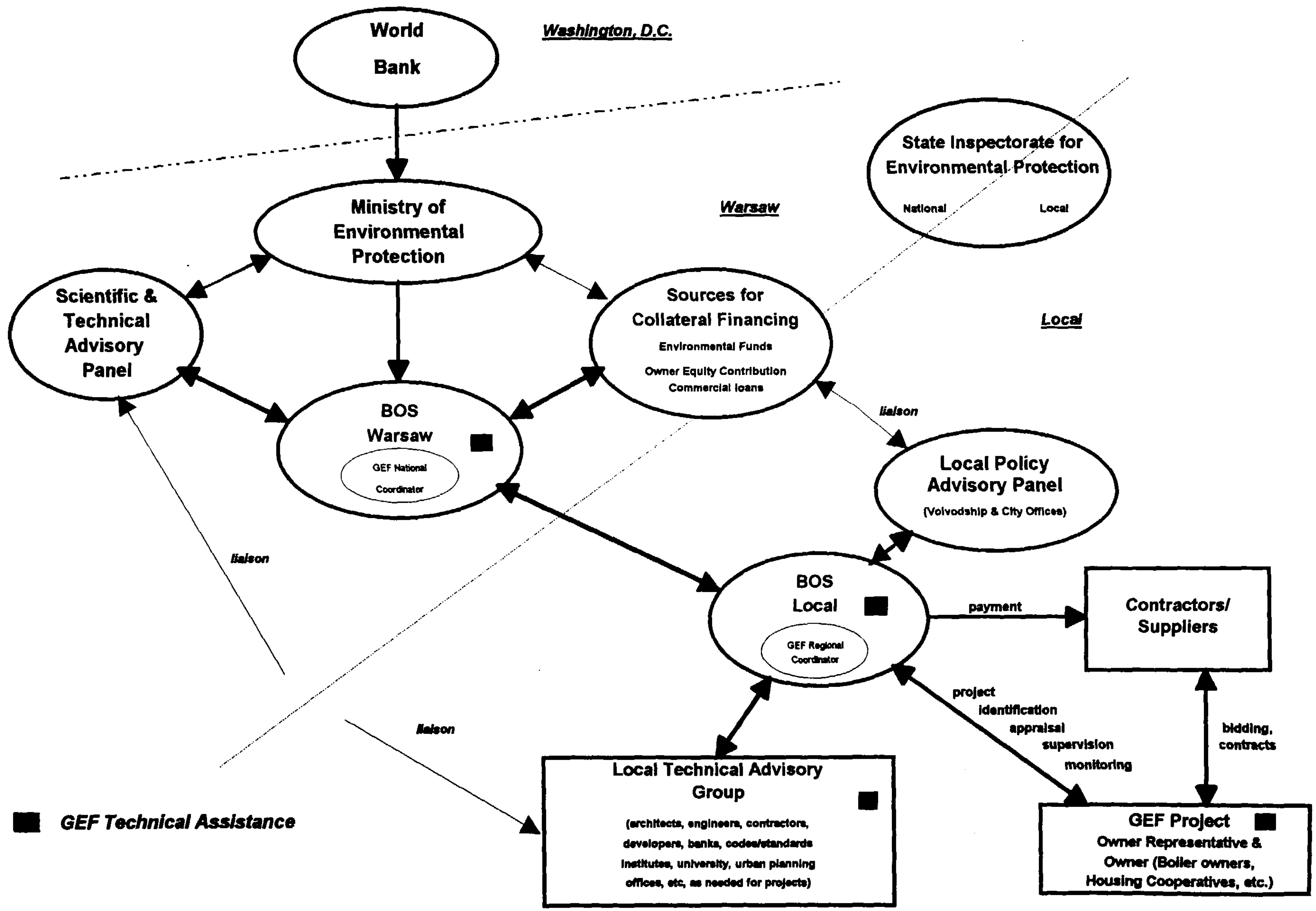
proposing, designing or building specific GEF projects.

38. The local technical advisors/TAG members would participate on a funded basis. Within GEF project funding constraints, the funding of local technical advisors and TAG members should be accomplished to ensure that the needed expertise is available to guide local and regional decision-making. Recruitment and payment would be carried out at the local BOS level.

39. **Other Participants in Specific GEF Projects.** For each specific project, the boiler owner, engineering consultants acting as the representatives of the boiler owners, engineering-procurement-construction contractors, environmental monitoring contractor, energy auditors and suppliers would participate in standard roles to accomplish designated activities (the roles of these groups are further identified in Annexes 8, 10, 11 and 20-24). For the overall GEF Project, other key project participants include contractors for the environmental monitoring and for the marketing program and external financial auditors.

POLAND - COAL-TO-GAS CONVERSION PROJECT

GEF Project Organization Structure



Annex 7
Figure 7-1

POLAND - COAL-TO-GAS CONVERSION PROJECT

Rules and Procedures for Processing Applications

The following rules and procedures have been identified for the application, selection and accomplishment of individual conversion projects. Rules and procedures for processing energy efficiency projects are briefly described in Annex 10. Figure 8.1 of this annex describes the typical overall flow of activities for a single project. The sequence shown in the figure and the descriptions below should together provide a detailed first draft set of rules and procedures. This draft will be refined during the pilot projects to produce a final set of rules and procedures that would be fully adapted to a range of in-country conditions and would be widely replicable with future projects. The proposed steps are as follows.

At the local level:

Step 1. Boiler Owner Decides to Participate: Bank Ochrony Srodowiska SA (BOS) announces publicly the GEF fund and its purpose using various information channels and makes application forms and other information on the GEF fund available to interested boiler owners, specifying a due date.

The boiler owner reviews the information provided, determines the project would meet the GEF criteria and decides to apply to take part.

Step 2. Boiler Owner Submits Application to BOS: The boiler owner completes at his/her own expense a standardized GEF application developed by BOS. This application would include: (a) a pre-feasibility study, prepared with the assistance of a qualified consultant if needed; (b) an environmental impact assessment (EIA), prepared with the assistance of a registered expert; (c) a letter of intent from the local gas distribution company to supply the gas; and (d) in the case of a cogeneration project, a letter of intent from the local electricity distribution company to purchase the cogenerated electricity. To carry out this task, the boiler owner may use local experts from a recommended list of experts established by BOS. Draft terms of reference (TORs) for the local experts are in Annex 24.

Step 3. Financial Pre-Qualification by BOS: The local BOS office evaluates the application for pre-qualification based on GEF criteria, including financial factors, together with other applications delivered to the BOS office within a given date. If the application does not meet the criteria, it is returned to the owner with a letter of explanation.

Step 4. **Technical Pre-Qualification by TAG:** The applications that meet the GEF criteria from the previous step are sent to the local Technical Advisory Group (TAG) for a site inspection and assessment of compliance with the GEF technical requirements. If additional information or clarification is needed, the local TAG would request this of the owner via the local BOS office. All formal communications between the GEF project and the boiler owner would be through the local and central BOS offices.

If the project does not comply with the technical requirements, BOS would return the application to the owner with a letter of explanation based on the findings of local TAG.

If a local TAG has not been established, the application would be forwarded for technical review either to a TAG in the region or to a technical advisor drawn from an approved list of registered local experts or even to the national Scientific and Technical Advisory Panel (STAP), as appropriate. Review by the national STAP should only be required for all complex projects involving, for example, cogeneration schemes. However, the local TAG members and technical advisors may liaise with STAP on technical matters, as necessary.

The services of the local technical advisors or local TAG members would be funded under the GEF technical assistance component. TORs for the local technical advisors and TAG members are in Annex 24.

Step 5. **Public Review:** All applications that meet the above requirements are sent to the respective local municipalities (*Gminas*). That initiates a public review of the concerned project and its EIA. The environmental review should address all environmental impacts of the project applicant, in accordance with the provisions described in Annex 9. The results of the public review are sent to the local BOS office as well as the *Voivodship*.

Step 6. **Cooperation with the *Voivodship*:** The local BOS office evaluates the pre-qualified applications in terms of financial requirements and cooperates with the *Voivodship* regarding both the financing and environmental issues of the projects. The project's status relative to *Voivodship* priorities is an important consideration. In addition, under current procedures, the *Voivodship* has final regulatory responsibility for ensuring compliance with the environmental criteria of the project.

Step 7. **Local BOS Final Approval/Disapproval:** The local BOS office makes its final approval/disapproval decision for each of the applications. Each disapproved application is sent back to the owner with a letter of explanation, while the locally approved projects are forwarded to the central BOS office.

At the Central Level:

Step 8. **Central BOS Office Review of Criteria:** The central BOS office conducts a check on the eligibility of candidate projects based on the GEF criteria. It does this routinely on a quarterly basis or as required to address a reasonable number of projects. The review can be considered simply a check of the actions of the local BOS offices. The timing of the review should be scheduled prior to the corresponding STAP meeting.

Step 9. **STAP Technical Review:** The national STAP checks the eligible applications for their local assessments. Its review covers technical aspects and cost-effectiveness of the project, and the GEF grant contribution to the project financing. In some cases, STAP may have already conducted a technical review (per step 4 above). STAP gives its evaluation to the central BOS office, with a copy to the Ministry for Environmental Protection, Natural Resources and Forestry (MoE). STAP's decision is final. STAP also expresses its opinion on the quality of the work done at the local level by the local BOS and TAG and provides recommendations and corrective actions, if necessary.

Step 10. **BOS Negotiates/Assembles Financing Package:** After STAP approves the applications, the central BOS office begins to negotiate a financing package for each application. The institutions involved would be the boiler owner, the National Fund, the *Voivodship*, BOS itself and possibly also commercial banks. In some cases, the Polish Debt-to-Environment Swap fund (EcoFund) may wish to finance some of the grant part, in which case the GEF contribution may be reduced.

Step 11. **Approve Financing Packages and Sign Contracts:** BOS approves the financing packages for the individual projects, as does the boiler owner, and they sign a sub-grant agreement. The sub-grant agreement specifies, inter alia, the amount of the GEF grant financing and provides for a review of this amount once the procurement packages for the goods and works are awarded and the project costs firmed up.

Step 12. **Terms of Reference for Engineering Consultants**: STAP: (a) formulates TORs for one or more consultants to design the detailed technical requirements for the individual schemes and to act as the representative of the boiler owner; (b) approves funding of the consultants from the GEF project; (c) reviews the consultants' products; and (d) designates a STAP member to oversee project implementation. For some projects, STAP may decide to delegate this function to the local TAG. Depending upon the size of the individual projects and their geographical distribution, STAP would decide upon the number of qualified engineering consultants to be hired and funded from the GEF project fund and upon the number of boiler owners to be represented by each individual engineering consultant.

Step 13. **BOS Hires Engineering Consultants as Boiler Owners' Representatives:** The central BOS office hires a consultant or consultants, following the Bank's Guidelines for the Use of Consultants, to develop the necessary technical and operational specifications for the project and to assist the boiler owners during all phases of project implementation. The Bank's prior approval would be required for consulting services beyond the Bank's prior review threshold (see Annex 16).

The consultant would also prepare for the monitoring at this time, including: (a) monitoring and measuring the existing facility to produce base case conditions; (b) developing a detailed monitoring plan, including identification of the monitoring system and equipment needed; and (c) advising the environmental monitoring contractor on the monitoring requirements for the project. The environmental monitoring contractor would conduct the pre-conversion monitoring of the environmental and technical performance of the existing facility during boiler operation (see Annex 11).

STAP would designate a member to follow up and review the work done. For some projects, STAP may decide to delegate this function to the local TAG or to local experts if a formal local TAG has not been established.

Step 14. **BOS Administers Bidding to Assist the Engineering Consultant:** The central BOS office assists the consultant(s) in the administrative part of the bidding for the goods and works to ensure compliance with the Bank's Procurement Guidelines. An Engineering, Procurement and Construction (EPC) contractor is selected.

The Bank would conduct a prior review of: (i) all procurement packages involving cogeneration projects and with funding levels in excess of US$300,000; (ii) the first three high-efficiency boiler packages; and (iii) the procurements of equipment following direct contracting procedures (see Annex 16 on the Bank's prior review requirement).

Prior to issuing the bidding documents for the goods and works, the boiler owners sign contracts with the local gas distribution company for long-term delivery of gas and with the local electricity distribution company for the purchase of electricity from cogeneration project.

The central BOS office would revise the financial analysis on the basis of the selected EPC bid to determine the final GEF grant amount. It would then finalize the financing plan and amend the sub-grant agreement to reflect the revised financing plan and GEF grant amount.

During project construction and operation:

Step 15. Construction and Installation: The engineering consultant acting as the boiler owner's representative supervises construction and installation.

Step 16. Commissioning and Acceptance: The local authorities (*Voivodships* and *gminas*) designate a committee consisting of the boiler owner, the engineering consultant, SIEP and other local/regional institutions responsible for energy, environment and infrastructure projects. The committee approves the installation and the project is formally turned over to the boiler owner. Both the engineering consultant who supervised construction and installation would participate in this approval process, including an evaluation of the installation operation. SIEP would also participate in this approval process, including an evaluation of the installation operation. The owner and the engineering consultant initiates the specially designed scheme for post-conversion monitoring. The engineering consultant reports to the central BOS office.

As the construction and installation of equipment are completed, each equipment would be inspected and tested to the extent the general state of construction permits. Each test would be performed in the presence of the boiler owner's representative as a part of the commissioning and acceptance process.

To the extent feasible the boiler owner's operating staff would operate the equipment and conduct the inspection and testing. The boiler owner's representative would prepare a report of this initial inspection and preliminary testing activity, noting any deficiencies. The EPC contractor would then correct these deficiencies.

When construction is completed, the entire system would be started up and operated at specific capacities and conditions over the period of time as designated by the boiler owner's representative or as contractually required. Since any district heating project has to be completed before the onset of the heating season, either special arrangements have to be made for full load testing when the true heating load is low, or full load testing may be delayed until colder weather.

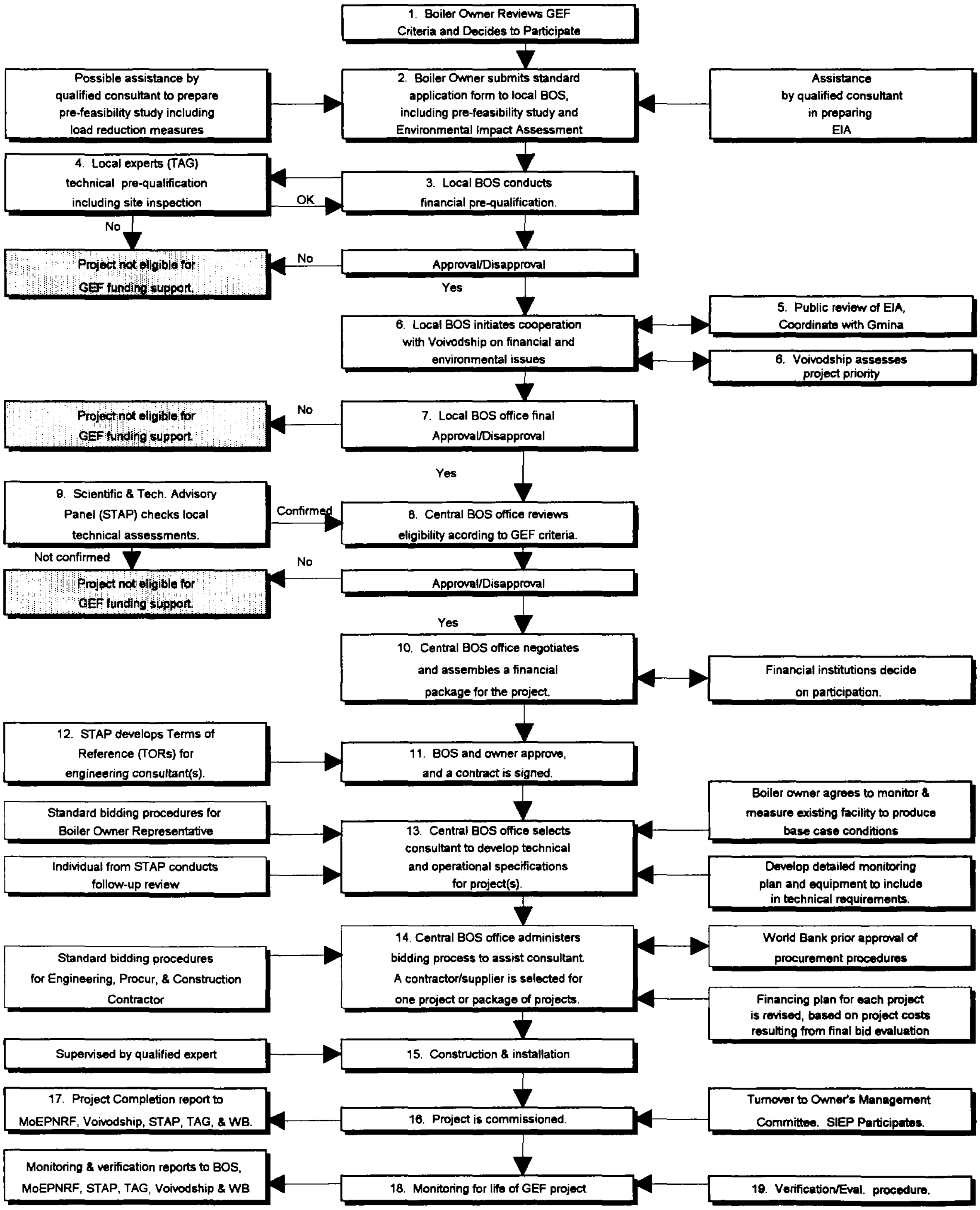
Step 17. **Project Reports:** The local BOS prepares progress reports and completion reports for individual projects and sends them to the central BOS office. If a local BOS office has not yet been established relative to a project, then the central BOS office prepares the progress reports and completion reports for that project. The central BOS office prepares summary progress reports covering all individual projects. It should send copies of summary progress reports and individual project completion reports to MoE, the Bank, STAP, TAGs, the *Voivodship*, the *Gmina*, and the boiler owner.

Step 18. **Monitoring:** The environmental monitoring contractor would conduct the post-conversion monitoring of the environmental and technical performance of the new facility, during the first year of operation.

Step 19. **Verification:** A small group consisting of some experts having participated in this process would, under the technical leadership of STAP, take part in the verification of systems operation, cost-efficiency and monitoring of emissions on a yearly basis. Reports on the results of the verification would be distributed to MoE, the Bank, BOS, STAP, TAG, the *Voivodship*, the *Gmina* and the boiler owner.

POLAND - COAL-TO-GAS CONVERSION PROJECT

Processing of Candidate Projects - Flow Diagram



POLAND - COAL-TO-GAS CONVERSION PROJECT

Environmental Aspects

Overview

1. **Introduction**. The proposed project has been placed in environmental screening category "B" consistent with the provisions of Operational Directive 4.01, "Environmental Assessment." The project was subject to the preparation of an environmental review for the demonstration activities (see "Proposed Demonstration Projects" below), and environmental guidelines have been developed for use in the GEF-Project Replicability Framework to be established under the project (see "GEF-Project Replicability Framework - Environmental Guidelines" below).

2. **Background**. Given the level and complexity of the environmental issues in the country, the Government of Poland, working through the Ministry of Environmental Protection, Natural Resources and Forestry (MoE) at the national level and a network of environmental protection departments at the local level, has undertaken an impressive program to address environmental issues through a diversity of policy actions, investment activities and programs to strengthen institutions. Since 1990, the ministry, with the cooperation of local governments in Katowice, Krakow and Legnica, has been implementing the Bank-funded Environmental Management Project (Loan 3190-POL), which has supported institutional development, including development of an improved capacity for air quality management. To support the development of a national policy concerning the substitution of gas for coal, the Bank cooperated with the Government in the preparation of an "Environmental Assessment of the Gas Development Plan for Poland" (1991). Coopers & Lybrand Deloitte prepared this report with the support of a wide variety of Polish experts. It analyzes the environmental issues and benefits associated with the production, import and use of gas.

3. Following cooperative preparation between the Bank and MoE, the Bank issued a major report, "Poland: Environmental Strategy" in 1992, that gave priority to the reduction of air pollution in major urban industrial areas for public health reasons. More recently, the recommendations included in the Bank report "Environmental Action Program for Central and Eastern Europe," endorsed by the European Ministers of Environment in 1993, places great emphasis on the substitution of gas for coal and the use of higher efficiency boilers as an important means of reducing the serious health effects from particulate emissions on a local scale and the impacts of SO_2 on a regional scale and CO_2 on a global level. This report specifies as high priorities for investment actions to reduce air pollution in southern Poland and the adjoining areas of the Czech Republic.

4. **Potential Environmental Impacts**. Implementation of the proposed project would result in the accelerated implementation of the Government of Poland's

policy of converting small and medium-size coal-fired boilers to gas-firing to reduce the serious air pollution problems in major urban-industrial areas, with resulting local benefits in air quality and environmental health. On a regional scale, such interventions would incrementally support the reduction of SO_2 emissions and contribute to a reduction of CO_2 emissions at a global level. The use of high-efficiency boiler technology would also reduce the total level of energy used and lower the rate of exploitation of domestic gas reserves and the level of natural gas imports.

5. The primary potentially adverse environmental impacts associated with the proposed project are: (a) waste management issues associated with the handling and disposal of asbestos wastes during the removal of old boilers; and (b) the risk of explosion associated with the piped delivery and use of gas in the boilers. Both these issues are well-recognized in Poland, and proper procedures would be used in the proposed project for the safe handling and disposal of asbestos and for assuring the safe installation and operation of the gas supply systems and gas-fired boilers.

6. Institutional Strengthening. The proposed project would contribute to a strengthening of Poland's capacity at the national and local levels in the areas selected for conversion activities under the project to: (a) plan and implement, on a national basis, innovative and cost effective types of environmental improvement activities, as supported under the proposed GEF project; (b) develop experience with the design, installation and operation of interventions to improve heat supply systems; (c) create an institutional capability to assessment global externalities such as CO_2 emission abatement in project analyses; and (d) improve the implementation of public awareness programs for energy conservation.

Proposed Demonstration Projects

7. The Setting. The City of Krakow and surrounding Krakow *voivodship* are one of five officially designated areas of ecological disaster in Poland. This area suffers from serious air and water pollution generated locally and from regional problems caused by the urban industrial center of Katowice immediately to the west. Air pollution in Krakow is acute during the winter heating season and causes serious problems to human health, damages natural resources and degrades the historical structures of the city, which is a UNESCO-designated World Heritage Site. Polish and foreign environmental health specialists have identified the emission of large amounts of particulates from the coal-fired boilers, which have relatively low stacks, as the highest priority problem to address in Krakow and other major Polish cities. Since 1989, the City of Krakow and the *Voivodship* of Krakow have actively worked with national and international technical and financial organizations, including the Bank, the US Department of Energy and the US Environmental Protection Agency, to address these problems.

8. Proposed Demonstration Sites. Because of the poor air quality in Krakow, which seasonally exceeds ambient standards, and the demonstrated ability of the local government to implement environmental improvement projects, the city of Krakow was selected for the implementation of the pilot activities for the

proposed project. Two sites have been selected for demonstration coal-to-gas conversions: (i) the Jana Street site and (ii) the Warszawska Street site. Both sites are in the central area of the city of Krakow and involve the replacement of low-efficiency coal-fired boilers in existing boiler houses with high-efficiency gas-fired boilers. Review of these sites by local authorities indicates there are no sensitive receptors in the area of the proposed facilities.

9. **Potential Environmental Impacts**. Bank environmental staff and Polish environmental authorities have both reviewed the proposed pilot projects and found them to be consistent with their respective environmental requirements. The Environmental Protection Department of the *Voivodship* of Krakow, which has clearance authority for projects of this type and scale under Polish environmental procedures, has issued an environmental clearance for these activities. Implementation of the proposed pilot activities in Krakow would have a positive impact on local air quality, especially during the winter heating season, and would contribute on an incremental basis to improved air quality regionally. In addition, these projects would complement the ongoing program in the city of Krakow to reduce pollution from small and medium-scale boiler houses. Project implementation would eliminate the use of 4,238 tons of coal per year and replace them with clean burning natural gas, a shift that would improve ambient air quality in the historic city center. On local and regional levels, the change in fuel types and the introduction of higher efficiency boilers would result in an average annual reduction of emissions of SO_2 by about 118 tons and of particulates by about 80 tons. The pilot activities would contribute global benefits through the reduction of CO_2 emissions by an estimated 10,050 tons per year.

10. **Environmental Mitigation Actions**. Review of the proposed activities indicated that the following mitigation actions need to be undertaken during implementation:

(a) **Removal and Disposal of Waste Materials**. The primary mitigation measure required is proper removal and disposal of an undetermined amount of asbestos, used to insulate the boiler houses. The amount of asbestos and its condition can only be fully assessed during demolition. The Bank would require that the contractors for this aspect of the proposed pilot projects remove the asbestos consistent with Polish requirements and good international practices, under the supervision of the local implementing agency. The Department of Environmental Protection of the *Voivodship* of Krakow would oversee the safe disposal of the asbestos wastes generated by the proposed pilot projects.

(b) **System Safety**. The use of gas as a fuel creates a potential risk of explosion that can be dangerous in urban areas. However, well-established mitigation measures exist to ensure that the design, installation of fuel supply systems, construction of boiler houses, and their operation and maintenance can be done safely. The proposed pilot activities would include provisions for an automatic gas monitoring and alarm system. Following both Polish requirements and international practices, installation and construction contractors would follow proper safety procedures and an emergency management system would be developed for each facility.

11. Institutional Strengthening. The proposed pilot project would strengthen the local implementing agency in the areas of planning, management and monitoring of this type of investment activity. Since 1990 the Department of Environmental Protection in the *Voivodship* of Krakow has participated in the Bank-funded Environmental Management Project and has developed a significant capability to supervise internationally funded environmental management projects. This department would oversee all environmental matters associated with the pilot projects.

12. Environmental Monitoring. The Department of Environmental Protection of the *Voivodship* of Krakow would be responsible for monitoring the proper removal and disposal of asbestos during the implementation phase of the proposed pilot projects. The recently installed Katowice-Krakow regional air quality monitoring system, funded with support from the US Environmental Protection Agency and the Bank's Environmental Management Project, would be used to monitor the operational performance of the proposed pilot projects. This system includes a network of stationary monitoring stations and mobile monitoring equipment for facility-specific monitoring.

GEF Project Replicability Framework - Environmental Guidelines

13. Introduction. These guidelines have been prepared to provide guidance to cooperating organizations and consultants in addressing the environmental aspects of proposed activities to be supported by the GEF Project Replicability Framework. The guidelines correspond to the environmental review procedures of the Government of Poland and the World Bank (Operational Directive 4.01 "Environmental Assessment"). These activities have been placed in World Bank environmental screening category "B" and require the preparation of an environmental review for each activity. Special attention should be given to the provisions of Annex C of World Bank Operational Directive 4.01, which provides information concerning the preparation of an environmental mitigation plan.

14. Environmental Review. For each proposed coal-to-gas conversion activity, an environmental review is to be prepared that provides: (a) a concise analysis of the potential environmental issues; and (b) identification of specific actions that should be taken to address their management. The environmental reviews should be no more than 5-10 pages except where complex site-specific problems are identified. In cases where the requested information is provided elsewhere in the feasibility study, it should be noted and cross-referenced in the text of the environmental review to avoid duplication. These reviews would require clearance by the Department of Environmental Protection of the concerned *voivodship*.

15. **Analysis of Potential Impacts**. The environmental review for each activity should provide a concise analysis of the potential environmental impacts of the coal-to-gas conversion projects, including the following:

(a) **Description of the Current System**. This description would include a brief overview of the elements of the proposed system, including the fuel type(s), location of the boiler(s) and air quality impacts from the boilers burning their present fuel. It should also have a map showing the key elements of the system with reference to current and proposed land use. If such information is provided in the feasibility study, it may be cross-referenced in the environmental review.

(b) **Description of Proposed Improvements to the System**. This description would include a brief overview of the proposed improvement to the system. It should include a map showing the key elements of the modified system with reference to current and proposed land use. If such information is provided in the feasibility study, it may be cross-referenced in the environmental review.

(c) **Identification of Potential Significant Environmental Impacts**. The review would include an analysis of the potential significant adverse impacts that are anticipated to arise from implementation of the proposed activity. Specific attention should be given to the following issues:

- System Modification/Replacement. The review should describe the potential environmental impacts, both positive and negative, associated with the modification and/or replacement of the system.

- Removal and Disposal of Waste Materials. The review should describe the potential issues associated with the removal of the waste materials associated with the conversion of the boiler and other modifications to the systems. Special attention should be paid to issues relating to the management of asbestos with regard to the amount used, its type and mixture. Information should be provided on how asbestos and any other debris from the rehabilitation should be removed, type of equipment to be used, personnel and safety procedures to be followed, transportation methods and secure disposal of the materials removed.

- Impact on Air Quality. The review should evaluate possible adverse impacts on air quality resulting from the operation of the boiler houses. The air quality analysis should include an evaluation of present air quality impacts and air quality impacts from the converted system and relate these to current

Polish environmental standards. The air quality analysis should identify the location of any sensitive receptors such as hospitals, schools or sanitoria that may be affected.

- System Safety Measures. The review should describe the provisions to be included in the proposed activity to ensure that the design and installation of the gas supply systems, construction of gas boiler houses, and their operation and maintenance are done safely.

- Environmental Clearances and Permits. The review should identify the environmental clearances or permits that are necessary for the proposed project.

16. **Environmental Mitigation Plan**. The review should provide an Environmental Mitigation Plan that identifies the proposed actions to be taken to address, in a cost-effective manner, the potential adverse environmental impacts associated with the implementation and operation of the proposed project activity. This information should include an explanation of the need for the proposed action, its estimated cost and identification of the institution(s) responsible for implementing the action.

17. **Environmental Monitoring**. The review should identify actions to be taken by the concerned utility, local government and/or local Department of Environmental Protection concerning environmental monitoring of the activities associated with the construction and/or operation of the proposed project activity. These activities may include actions concerning the disposal of waste materials from conversion of the system.

18. **Institutional Strengthening**. The review should identify any specific institutional strengthening and training that may be required to address the environmental issues associated with implementation of the proposed activity.

POLAND - COAL-TO-GAS CONVERSION PROJECT

Residential Energy Efficiency
Within the GEF Coal-to-Gas Conversion Project

Residential Energy Efficiency Context

1. Application to Existing Residential Buildings. Many of the anticipated boilers to be converted from coal to gas within this GEF project would be supplying heat to existing buildings, in particular to existing residential buildings. Many existing residential buildings are inefficient high-rise apartment blocks. Each GEF boiler conversion project would involve evaluation and implementation of cost-effective improvements in end-use efficiency. For those conversion projects that involve boiler replacement as part of the coal-to-gas conversion, improved building energy efficiency could result in a downsizing of the replacement boiler. Thus, examination of cost-effective energy-efficiency retrofit measures for existing residences would be part of applicable boiler conversion projects.

2. Application to New Residential Buildings. During the appraisal phase of this GEF project, several new housing projects were examined as possible candidates for a total energy housing pilot project. The concept was to combine highly energy-efficient residential construction and operations with a boiler conversion project including a combined heat and power system to produce an extremely energy-efficient housing project compared with existing practice. Upon closer examination of each project, including review of project drawings and site visits, each project was determined to be unsuitable for the GEF coal-to-gas conversion. Most of the housing projects were either constructed adjacent to a main district heating system supplied by an efficient combined heat and power (CHP) plant (in which case no additional heat source is needed) or were already planned to use natural gas (in which case the coal-to-gas conversion concept is inapplicable).

3. Further factor has been a recent major change in the nature of Polish residential construction. Traditionally most existing residential units have been built as high-rise apartment blocks. Today these are far less desirable than single family dwellings or low density townhouse complexes. Consequently, most new housing projects involve single family dwellings or townhouses. A shortage of both construction and mortgage financing forces new housing complexes to be constructed in several stages of about 100 units each or less. Because lower densities reduce the cost-effectiveness of a central heating plant and because of other factors including cleaner operation, most new projects are opting for individual gas furnaces in each unit. Because of scarce financial resources and undeveloped market channels, the gas heating systems being installed have low efficiencies compared with the efficiencies routinely used in the Western Europe and US markets.

4. Present construction practice together with present energy prices inhibits solutions to new housing construction practices with minimal negative

environmental and energy impacts. Typical current construction practices, while they include double panel windows and insulation levels at code thickness, need better construction detailing to achieve the energy savings indicated by the provisions of the code.

5. Even where new units are constructed, scarce resources force a focus on a minimum first cost, and only rudimentary levels of energy efficiency are currently considered or are likely to be considered in the future. Already the standards for building energy-efficiency in Polish codes are low compared with European ones. Unfortunately, this situation virtually precludes the establishment of local markets for the wide variety of advanced energy-efficiency housing products -- insulation, glazing, lighting and appliances -- that are widely available internationally and only a short distance away in Western Europe. Likewise, an energy service industry does not exist, nor is an effective one likely to develop in the near future because of the lack of sufficient construction or ability to include more expensive options in housing units that are already too expensive for most people. The considerable technical skills that exist in Poland cannot be applied to housing construction.

6. While the effort to find a total energy housing pilot project prior to the appraisal of the GEF Coal-to-Gas Conversion Project was not successful, a number of valuable lessons were learned:

(a) A number of new housing projects do fit the GEF Coal-to-Gas Project criteria. Especially applicable are those projects in which new in-fill housing is planned adjacent to existing apartment units with a coal- or coke-fired heating plant, and the new housing plans to tap into existing boilers. A follow-up project that could be eligible for financing under the GEF project could involve a combination of: (i) the coal-to-gas conversion of the existing boiler house with energy efficiency improvements in the existing heat distribution, transfer and end-user systems; and (ii) high-efficiency energy design and equipment for the new housing units, whether they are apartments, townhouses, houses or a mixture.

(b) From a national perspective, current Polish standards for housing energy efficiency need to be revised to reach optimal levels for energy efficiency; and

(c) Changes in current construction and inspection practices, through simple, pragmatic education of contractors, workers and inspectors in conjunction with demonstration projects to encourage revised practices, would improve energy efficiency.

7. Identifying and implementing a total energy housing pilot project and other energy efficiency housing projects within the GEF Coal-to-Gas Conversion Project remain a high priority.

Energy Efficiency Fund for New Residential Buildings

8. The need to reduce the energy costs of housing is considerable. The Poland

- Housing Project (Loan 3499-POL) limits mortgage payments to 25 percent of monthly family income. The maximum mortgage amount is 36 times monthly family income. These limits essentially permit allowable funding to cover basic construction costs; use of the loan fund for energy-efficient materials and equipment is severely constrained.

9. Meanwhile, the cost of heating houses has risen sharply. In 1989 house heating bills for individual homes, which were subsidized, were less than 0.5 percent of income. Since 1990 energy pricing reform has made major progress, bringing about significant increases in the prices of network fuels (about 60 percent of their estimated economic levels). Heating costs have quickly increased from an incidental level to a significant portion of total housing costs: as of the end of 1993, house heating bills were about 12 percent of disposable income. By 1994-95, housing heating bills are expected to reach 15-17 percent of disposable income. Thus, the cost to heat houses is about one-half the proposed mortgage payment, and may soon rise to a higher proportion of the mortgage.

10. Calculations have not yet been made for reducing energy use in new houses from current levels to economically optimal levels for the country. Further, the latter has not yet been determined. However, energy reductions in new housing construction of about 30-35 percent should be cost-effective. These reductions could be achieved by increasing window insulation by 30%, doubling wall insulation, and increasing roof insulation by two or three times.

11. An Energy Efficiency Fund (EE Fund) under the GEF project would have the following objectives: (a) implement a pilot program for energy efficiency in new residential buildings: (b) permit practical experience to be attained; and (c) initiate the building-up of housing energy efficiency equipment in local markets.

12. The proposed set-up for the EE Fund would be as follows:

(a) The EE Fund would be provided to applicants who have secured construction financing.

(b) BOS would manage this project component with the assistance of qualified energy auditors.

(c) The EE Fund would grant-finance incremental energy efficiency and conservation measures.

(d) A free energy audit would be provided to applicants provided that they would agree to: (i) implement the measures identified by BOS' energy auditors for improving the energy efficiency of the applicants' architectural design and construction; and (ii) allow BOS' energy auditors to carry out periodic site inspection during construction and installation of energy-efficient equipment and monitor the performance of the new residential units for one year of occupancy of the residential units by the unit owners/tenants.

(e) The beneficiaries of the EE Fund would be owners of new residential buildings. Developers could also apply to the EE Fund provided that they do not change the prices of the residential units as agreed between the developers and the qualified buyers. The latter would be the final owners of the residential units. This would ensure that the final beneficiaries of the grant are the owners of the new residential units and that the developers are not increasing their profit through the GEF grant.

Energy Efficiency Fund

13. Types of Housing Projects. Most of the housing projects have an average size of 60 units per project, with a range of 8 to 148 units. To date, the majority of new housing is multi-family, multi-story building projects, with limited area for commercial space. The average size of each unit is 67.9 square meters (m^2) in net usable area, and the average cost per unit is US$19,700. A few housing projects now are either single family or townhouse, but that number is expected to increase as the economy improves. In that case, the average size and unit cost will increase, as the average size of a single family unit is about 120 m^2 of net usable area.

14. Energy Efficiency and Conservation Measures. The Warsaw Energy Conservation Foundation carried out a preliminary energy analysis on a single family detached, two-story building, with a heated space of 150 m^2 and a volume of 500 cubic meters (m^3), using a computer software program for assessing housing efficiency. For such a building, the heat energy consumption based on current minimal Polish standards would be 101.81 kWh/m^2. A 20 percent reduction in heat consumption can be achieved at minimum cost by: (a) increasing the wall and ceiling insulation by 4 and 17 centimeters, respectively (equivalent to an increase in thermal resistivity (or R-value) of about 1.6 $m^{2o}K/W$ for wall insulation and 3.5 $m^{2o}K/W$ for ceiling insulation)[1/]; and (b) improving the window insulation standard (reducing the conductance or U-value from 2.6 $W/m^{2o}K$ to 2.0 $W/m^{2o}K$). These measures together would reduce heat consumption to 81.32 kWh/m^2.

15. Better automation and control of heat consumption can provide an additional 10 percent reduction in heat consumption. This reduction would bring the heat consumption factor down from 81.32 to 73.19 kWh/m^2. This savings could be achieved by increasing the efficiency of the heat installation, using efficient heat radiators, the installation of thermostatic valves, and the installation of building heat measuring systems with evaporator meters at unit levels for cost-

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1/

The heat losses by conduction through a building component (such as wall, window and ceiling), expressed in Watt (W), are calculated by multiplying the conductance of the component by the area of the component (in square meters (m^2)) and by the temperature difference (in degree Kelvin (°K)) between the inside temperature and the outside temperature. The inside temperature is the average temperature of the room for walls and windows or the average temperature at the ceiling. The outside temperature is the summer or winter design temperature for the geographical location considered. The conductance (or U-value), expressed in $W/(m^2\ {}^oK)$, is specific to the building component and is also defined as the inverse of the thermal resistivity, which is expressed in $m^2\ {}^oK/W$. For a given area of the component and a given temperature difference, the heat losses would decrease as the conductance decreases (or as the thermal resistivity increases).

sharing.

16. An additional 20 percent reduction in heat consumption could be achieved by introducing a heat recuperator. Acting as a heat exchanger, this device uses heat from the exhaust air to pre-heat the outside air used for ventilation. Besides its energy conservation benefit, it also permits better control of the ventilation for improved air quality in the building. This device would bring the heat consumption factor down from 73.19 to 43.26 kWh/m^2.

17. The introduction of energy-efficient appliances together with education for homeowners on how to conserve energy could reduce electricity consumption by 15-25 percent. This reduction would bring the electricity consumption factor down from its present estimated level of 12.76 kWh/m^2/person to an estimated level of 9.57 kWh/m^2/person.

18. **Energy-Related Construction Costs**. Energy efficiency and conservation measures would be evaluated case-by-case. Their costs could range from US$1,155 to US$1,400 per apartment unit [2/]. For example, without the heat recuperator, the incremental cost of the energy efficiency measures is estimated at about 2.53 percent of current total construction costs; with the heat recuperator, it is estimated at 4.6 percent of current total construction costs.

19. **Energy Efficiency Fund**. US$1.0 million is proposed for the EE Fund under this GEF project. Depending on the energy efficiency and conservation measures considered, the fund would provide incremental financing for improvements in about 600 to 800 new residential units over a 36-month period. Expected disbursements of the fund would be US$250,000, US$475,000 and US$200,000 in the first year, second year and third year of the project, respectively. The remaining US$75,000 would cover BOS' management fee (US$25,000) and energy audits (US$50,000). The audits would consist of: (a) an evaluation of the baseline (or existing) conditions; (b) an energy estimate of the baseline; (c) an evaluation of the energy measures to be used; (d) an energy estimate of the new conditions; (d) quality control and site inspection during construction; and (e) monitoring of the energy consumption of the constructed units for one year of occupancy of the new residential units by the unit owners or tenants.

20. **Availability of Technical Skills**. Poland has the analytical skills needed for the technical and cost-effectiveness analysis. The Polish Building Research Institute has analyzed energy options in housing and has produced a primer on the subject. Other institutes, such as the Polish Energy Conservation Foundation, have developed a simplified energy analysis software program (similar to programs in use in Canada and the United States) for use in housing. They are training technicians in each region in its use.

2/ The costs of energy efficiency and conservation measures for apartment unit were conservatively estimated by interpolating the results of the analysis made on the single family detached, two-story building, including related costs of measures, to a 68-m^2 apartment unit.

POLAND - COAL-TO-GAS CONVERSION PROJECT

Environmental Monitoring Program

Coal-to-Gas Conversion Component

1. Objective. The objective of the environmental monitoring program for the coal-to-gas conversion component of the project is to provide data to assess the energy savings, emission reductions and cost-effectiveness factors associated with the conversion of coal-fired boilers to natural gas firing rather than a monitoring program concerned with regulatory functions whose objective is to enforce air quality standards to control air pollution. Specialist contractors would implement the monitoring program under the supervision of the Ministry of Environmental Protection, Natural Resources and Forestry (MoE). In order to assure the standardization of data collection and analysis procedures, a single contractor acceptable to the Bank would be responsible for conducting the monitoring activities on a nation wide basis for the implementation phase of the coal-to-gas conversion component of the project. In its supervision task, MoE would be assisted by the State Inspectorate for Environmental Protection (SIEP) and SIEP's regional *voivodship* inspectorates.

2. Scope of Work. The monitoring activities under the project would consist of:

(a) the collection of data on ambient air quality where it is available from existing monitoring systems such as in the Katowice-Krakow region;

(b) the establishment of baseline data for the two pilot projects in Krakow;

(c) the development of a plan for data to be collected for a representative sample of boiler types during the implementation phase of the conversion program, including: (i) the specification of the parameters to be monitored and of the standardized procedures for their reliable measurement; (ii) the types of measuring instruments to be used; and (iii) the procedures to be used for the calibration and inter-calibration of the instruments to be used for the monitoring; and

(d) the specification of standardized methods for the analysis and presentation of data collected for individual projects, including the development of a standardized format for monitoring and reporting; and

(e) the implementation of the individual monitoring services for the follow-up conversion projects, at the project sites, to be conducted on the basis of individual work orders.

3. **Monitoring of Individual Projects**. The monitoring of individual projects, as discussed below, consists of the pre-conversion and post-conversion monitoring of the environmental and technical performance of the individual projects.

4. Pre-conversion Monitoring. As soon as the Scientific and Technical Advisory Panel (STAP) approves an application to participate in the coal-to-gas conversion project, the boiler owner is obliged to start the following pre-conversion monitoring activities, according to a given design and equipment that are supplied to the owner:

(a) Data on ambient air quality should be collected over a one-year period, where monitoring systems have been established; and

(b) Pre-conversion boiler performance monitoring during operation would include the following:

(i) The ***emission monitoring*** would consist of the monitoring of the emissions of greenhouse gases (carbon dioxide) as well as local polluting gases (nitrogen oxides, sulfur dioxides, volatile organic compounds and particulates) from the existing coal-fired boiler; and

(ii) The ***technical monitoring*** would consist of the monitoring of parameters critical to the performance and efficiency of the overall energy supply, distribution and consumption system and would include:

(1) an assessment of the condition of the boiler and auxiliary equipment; energy, water and carbon balances; boiler performance over its normal load range; monitoring of power consumption and other parameters critical to overall boiler efficiency; and

(2) an assessment of the conditions of the heat transfer and distribution systems and end-user facilities served by the existing boiler, including an estimation of the power and energy consumption and of the heat and water losses in these systems.

The pre-conversion monitoring would permit to report on the environmental and technical performance of the individual project on an annual basis. The results of this monitoring would, together with the calculations based on information given in the application, define the base case conditions that would provide the reference framework to permit measurement of the global and local environmental benefits.

5. The implementation of the pre-conversion monitoring activities at the project site, including the design of the monitoring system and the identification of the equipment needed for the pre-conversion monitoring phase, would be the responsibility of the specialist contractor. The Bank Ochrony Srodowiska SA (BOS) should immediately take the necessary steps to ensure that monitoring of the old boilers, prior to conversion, starts upon approval of each boiler conversion proposal by STAP.

6. Post-Conversion Monitoring. A monitoring plan, design of a monitoring system, and installation of monitoring equipment would be an integral part of the installation of new gas-fired boilers supported under this project. Post-conversion monitoring of emissions and technical performance, together with collection of data on ambient air quality (see para 3.(a) above), would also be carried out for the new facility. Post-conversion monitoring would be accomplished and reported for each boiler conversion project and for a one-year period after the commissioning of the new facility. As needed, MoE may define further monitoring and reporting obligations.

7. Design of the monitoring system and identification of the equipment needed for the post-conversion monitoring phase mentioned above, at the project site, would be the responsibility of the boiler owner's representative, in consultation with the specialist contractor. The implementation of the post-conversion monitoring activities at the project site would be the responsibility of the specialist contractor.

8. **Reporting**. Upon completion of the pre-conversion and post-conversion monitoring activities for an individual conversion project, BOS, together with the boiler owner and the specialist contractor, would prepare a monitoring report. This report would be a supplement to the project completion report for that individual project.

9. **Verification**. MoE would, together with SIEP and a small group of experts who have participated in the monitoring process, establish a process for verifying system operations, cost-effectiveness and monitoring of emissions. This "verification" process might be conducted yearly for all projects or randomly for some projects. MoE would prepare a verification report for the overall GEF project that contains the verification for individual projects and submit it to the Bank.

10. **Budget**. US$250,000 have been allocated under the GEF project to cover all monitoring related services for the coal-to-gas conversion component of the project.

Energy Efficiency Projects in New Residential Buildings (EE Fund)

11. Importance of Quality Control. To achieve the expected energy savings and minimize the environmental impacts, an energy conservation incentive program for new residential buildings would need careful quality control mechanisms. Recent incentive programs to retrofit existing apartment blocks have wasted resources because of the lack of quality control. The prices were too high and the quality of installed insulation too low. Experience has already been gained in Poland about the need for this type of program control.

12. **Energy Audit and Monitoring**. An energy audit and monitoring would consist of the following five tasks: (a) assessment of the architectural design to produce the baseline condition; (b) identification of the cost-effective incremental energy efficiency and conservation measures to be included in the project design; (c) design and specification of the quality of all building supplies and components that would be installed, along with specification of the standards to follow for the construction and installation of identified energy-efficient building supplies, components and appliances; (d) regular site inspections of the construction, including a final inspection for acceptance by the owner; and (e) evaluation of project performance, over a one-year period of occupancy of the new residential units by owners or tenants. During the first task, care must be taken to assure that the prices of the energy conservation measures to be used are not artificially raised. This concern may be addressed by, for example, using standardized costs and cost ceilings, insuring competition among suppliers and contractors and imposing ceilings on GEF support levels. During the second task, care must also be taken to assure, and confirm, that the quality of the goods used and construction meets the standards set. Several things are required to assure quality: (a) clear criteria and specifications for the energy measures; (b) clear identification of which measures are selected for a project; and, (c) a well-defined verification/validation procedure for checking, by qualified energy auditors, that the contracted measures are actually installed in accordance with the specifications and are operating properly.

13. **Energy Auditors**. An energy audit would be required for all projects supported by the EE Fund, to be financed from the fund. In order to assure the standardization of energy audit procedures, a single contractor acceptable to the Bank would be responsible for conducting the energy audit-related activities on a nation wide basis for the implementation phase of the energy efficiency component of the project. Energy auditing services for individual energy efficiency projects would be conducted on the basis of individual work orders.

14. **Budget**. US$50,000 were allocated under the GEF project to pay for the services of energy auditors.

POLAND - COAL-TO-GAS CONVERSION PROJECT

Project Implementation Activities

1. Three important project implementation activities need to begin immediately after completion of project negotiations: (a) selection of an owner's representative for the pilot projects in Krakow (both Jana Street and Warszawska Street); (b) preparation of a nationwide GEF program (first round of candidate projects); and (c) implementation of a GEF marketing plan. Each of these activities would include substantial involvement of Polish project participants and would occur simultaneously.

2. These activities are important for three reasons. First, they would produce the key standardized project documents and procedures needed for replicability. Second, they would require the formation of key project management and technical groups such as the Scientific and Technical Advisory Panel (STAP) and core team at Bank Ochrony Srodowiska SA (BOS), the implementing agency. Third, they would provide an opportunity to initiate technical assistance on a pragmatic basis early in the project. Successful accomplishment of these activities would permit an early start of full-scale project investment activities upon the completion of the project negotiations.

Selection of an Owner's Representative for the Pilot Projects in Krakow

3. The first tranche of pilot projects in Krakow (Jana Street and Warszawska Street) are already well-developed, and steps 1 through 11 of the project flow diagram in Annex 8 have effectively already been accomplished. For these two pilot projects, the activities funded under the Project Preparation Advance fund would permit initiation of the remaining tasks shown in Annex 8 (tasks 12 through 19). Thus, these first two pilot projects can proceed rapidly through the steps of detailed design, construction, commissioning, operation and monitoring upon selection of qualified consultants to act as boiler owners' representatives. Terms of Reference (TORs) for the boiler owners' representatives for the pilot projects are presented in Annex 22. The Polytechnic University of Krakow and the municipal district heating enterprise of Krakow (MPEC Krakow) prepared a Letter of Invitation for Consulting Services, cleared it with the Bank, issued it to a short-list of qualified consulting firms approved by the Bank and are now reviewing the proposals received.

4. Activities on these pilot projects would continue throughout the project preparation phase and be completed during the early stages of the full project following the completion of project negotiations.

Preparation of a Nationwide Program (First Round of Candidate Projects)

5. Beginning the first round of projects under a full nationwide program would require accomplishing for the first time (on a more formal basis) steps 1 through 11 of the project flow diagram in Annex 8. Some 20 potential projects

in several regions had been identified by the end of the appraisal mission. Additional projects would be identified from these and other regions, and the set of applications would be evaluated together.

6. Forming project teams. Initiating the first round of projects under the full GEF program would be accomplished primarily by the key Polish project teams, in a "learn-by-doing" mode, with substantial assistance from experts participating on STAP and from qualified consultants on project appraisal, implementation and administration. BOS has already established a core GEF project implementation unit (PIU) comprised of three staff in Warsaw working full-time on the GEF project, assisted by two part-time staff in Krakow. It plans to expand its PIU as individual projects develop. The BOS/GEF core team received training on the Bank's procurement and disbursement procedures and will receive further comprehensive and intensive training in these areas.

7. The next necessary step is to select the STAP members (Polish as well as foreign experts) and to recruit qualified consultants to assist BOS in developing application forms and in evaluating first-round projects. The Ministry of Environmental Protection, Natural Resources and Forestry has received expressions of interest from several potential foreign and Polish candidates for STAP and has selected STAP members. It has submitted information on the candidates for the panel to the Bank for approval.

8. The overall roles and responsibilities for these groups are described in Annex 7. TORs have been developed for the identified individuals or groups to cover project implementation activities: these are presented in Annexes 21 to 24. Contracts for their services must be put into place upon the completion of project negotiations.

9. Developing an Operations Source Book. Once STAP and the selected consultants are in place, their first task would be to develop an Operations Source Book for the GEF Coal-to-Gas Conversion Project under the supervision of the BOS core team. This Operations Source Book would contain examples of all the forms and procedures needed to accomplish the project development cycle. For example, it would include standardized application forms, detailed eligibility criteria, evaluation forms and procedures, form letters, draft TORs. Draft versions of some of these materials have already been developed; they are shown in Annexes 4, 8-11 and 20-24. These drafts would be refined during the following steps.

10. Training and Review Workshop. This workshop would be held to discuss and test the materials in the draft Operations Source Book. Members of STAP, local experts and Technical Advisory Groups and BOS should participate. This workshop is a key part of the project implementation activities, aimed at ensuring that key project participants would have a common and consistent understanding of the project's objectives and procedures. The workshop would contain sufficient detail to permit the technical team members and BOS core implementation team to assist boiler owners to complete the application forms and evaluate the information submitted. The workshop should place special focus on reviewing and refining the GEF project evaluation criteria for clarity and appropriate detail to minimize problems during the first round of project applicants. Technical

assistance requirements, mechanisms and procedures would also be discussed. It is expected that some refinement of the contents of the GEF Operations Source Book would result from discussions at the workshop. The workshop would also be used to test the concepts and content of the proposed project marketing seminars.

11. Special Assistance for First-Round Applicants. The BOS core team and STAP should be prepared to provide an extra level of assistance to boiler owners interested in applying during the first round. This special assistance should focus on helping boiler owners and/or their representatives assess if their projects are likely to meet the GEF criteria, in particular, to ensure that they meet the basic criteria before the owners spend funds on pre-feasibility studies and on environmental impact assessments. Thus, this activity amounts, though an informal assessment, to a type of financial and technical pre-qualification that avoids unnecessary expenditures on obviously unqualified projects (see steps 3 and 4 of Figure 8.1 of Annex 8).

12. Evaluation Workshop. When sufficient applications have been received, STAP members, including the international ones, and the BOS core team would meet and review, present and discuss the project applicants relative to both financial and technical criteria. The workshop would have four objectives: (a) to select the projects to be included in the first-round of boiler conversions; (b) to refine the evaluation criteria; (c) to refine the GEF Operations Source Book; and (d) to review and refine the marketing program, based upon the lessons learned from the first round of applications.

13. Continuation of the Development of the Projects Selected. Following the evaluation workshop, BOS would begin to administer the projects selected, according to the activity sequence listed in Figure 8.1 of Annex 8. STAP should be prepared to provide continued technical assistance, as necessary, for the projects.

14. Refinement of the GEF Operations Source Book. BOS should incorporate the refinements identified from the first round of applications and the evaluation workshop. This revised version should be suitable for distribution to and use by technical experts and local BOS offices in designated regions and locales.

Implementation of the Marketing Plan

15. A draft marketing plan for the GEF project and drafts of key marketing documents was completed prior to the project negotiations. This completion would set the stage for implementation of a comprehensive promotion of the GEF project immediately after effectiveness of the GEF grant. Key marketing allies would be identified and contacted early and key marketing resources -- a brochure and seminar contents -- would be prepared for use at the outset of full project activities. TORs for the marketing plan are contained in Annex 25.

POLAND - GEF COAL-TO-GAS CONVERSION PROJECT

Project Costs
Krakow Pilot Project - Base Costs

	US$ thousand		
	Local	Foreign	Total
Base Costs for Condensing Boiler Scheme at Jana Street			
Natural Gas-fired boilers, incl. firing, 3 x 0.5 MWth		90	90
Connection of outflow and return-flow to the existing accumulators and distributors, and to boiler-house 1	20		20
Exhaust-side connection to stack	5		5
Fuel side connection to natural-gas network	10		10
Conversion of existing stack to condensing boiler operation		45	45
Water treatment (partial desalineation and degasing)	20		20
Building improvements	10		10
Provision for safe removal and disposal of asbestos	30		30
Total Plant	95	135	230
Gas Pipeline	50		50
Energy conservation measures in consumers' buidlings		50	50
Engineering and Project Management Services /a	5	15	20
PROJECT BASE COSTS AT JANA STREET	150	200	350
Base Costs for Cogeneration Scheme at the Polytechnic University			
Packaged Cogeneration Unit			
Gas-turbine, 1.3 MWel			
Waste heat recovery boiler, steam 2.2 MWth			
Stack			
Hydraulic connection			
Water treatment			
Dual-fuel supply (gas and light oil)			
Gas compressor			
Hot water storage			
Sound-proofing			
Total - Cogeneration Unit		1,700	1,700
Peak boilers			
Hot water boilers, 3 x 1.5 MWth	170		170
Steam Boilers, 2 x 0.7 MWth	110		110
Electrical connections to grid & regulation	620		620
Steam pipeline for connection University/Citizens Home	150		150
Building Improvements	190		190
Other miscellaneous	340		340
Provision for safe removal and disposal of asbestos	150		150
Total Plant	1,580	1,700	3,280
Gas Pipeline	380		380
Energy conservation measures in consumers' buidlings	230	230	460
Engineering and Project Management Services /a	50	250	300
PROJECT BASE COSTS AT POLYTECHNIC UNIVERSITY	2,240	2,180	4,420
TOTAL BASE COSTS - KRAKOW PILOT PROJECT	2,390	2,380	4,770

Note: /a Average costs of services for Boiler Owner Representatives, covering multiple individual projects.

POLAND - COAL-TO-GAS CONVERSION PROJECT

Project Costs - Investment Component
(US$ thousand)

NUMBER OF GEF INDIVIDUAL PROJECTS

	1995	1996	1997	1998	1999	2000	Total
Cogeneration Technology	1	3	2				6
High Efficiency Boiler Technolgy	1	20	17				38

AVERAGE COST PER CONVERSION TECHNOLOGY

	Cogeneration	High Efficiency Boiler
Base cost	4,420	350
Physical contingency	442	35
Price contingency	238	18
Total cost	5,100	403

TYPICAL DISBURSEMENT PROFILE (YEAR 1 = YEAR OF PROJECT APPROVAL)

	Year 1	Year 2	Year 3
Cogeneration System	15%	75%	10%
High Efficiency Boiler System	35%	65%	

INVESTMENT COMPONENT (INCLUDING ENGINEERING AND PROJECT MANAGEMENT SERVICES)

	1995			1996			1997			1998			1999			2000			TOTAL		
CONVERSION COMPONENT	L	F	T	L	F	T	L	F	T	L	F	T	L	F	T	L	F	T	L	F	T
High Efficiency Boiler Systems																					
Base cost	58	65	123	1,262	1,415	2,678	3,127	3,506	6,633	1,823	2,044	3,868							6,270	7,030	13,302
Physical contingency	6	7	12	126	142	268	313	351	663	182	204	387							627	704	1,330
Price contingency				32	35	67	158	178	336	140	157	297							330	370	700
Total cost	64	72	135	1,420	1,592	3,013	3,598	4,035	7,632	2,145	2,405	4,552							7,227	8,104	15,332
Cogeneration Systems																					
Base cost	379	293	672	3,003	2,328	5,331	6,604	5,118	11,722	4,467	3,462	7,930	488	378	866				14,941	11,579	26,521
Physical contingency	38	29	67	300	233	533	660	512	1,172	447	346	793	49	38	87				1,494	1,158	2,652
Price contingency				75	58	133	334	259	593	344	266	610	51	39	90				804	622	1,426
Total cost	417	322	739	3,378	2,619	5,997	7,598	5,889	13,487	5,258	4,074	9,333	588	455	1,043				17,239	13,359	30,599
Total Conversion Component																					
Base cost	437	358	795	4,265	3,743	8,009	9,731	8,624	18,355	6,290	5,506	11,798	488	378	866				21,211	18,609	39,823
Physical contingency	44	36	79	426	375	801	973	863	1,835	629	550	1,180	49	38	87				2,121	1,862	3,982
Price contingency				107	93	200	492	437	929	484	423	907	51	39	90				1,134	992	2,126
Total cost	481	394	874	4,798	4,211	9,010	11,196	9,924	21,119	7,403	6,479	13,885	588	455	1,043				24,466	21,463	45,931
Energy Efficiency Fund for New Residential Buildings		125	125		363	363		337	337		100	100								925	925
TOTAL INVESTMENT COMPONENT	481	519	999	4,798	4,574	9,373	11,196	10,261	21,456	7,403	6,579	13,985	588	455	1,043				24,466	22,388	46,856

Notes: L: Local cost; F: Foreign cost; T: Total cost
Total costs include engineering and project management services estimated at US$250,000 per cogeneration project and US$15,000 per high efficiency boiler project.

POLAND - COAL-TO-GAS CONVERSION PROJECT

Project Cost - Technical Assistance Component /a /b
(US$ thousand)

	1995			1996			1997			1998			1999			2000			TOTAL		
	L	F	T	L	F	T	L	F	T	L	F	T	L	F	T	L	F	T	L	F	T
BOS MANAGEMENT FEE																					
Start-up costs		55	55																	55	55
Performance fee /c		25	25		122	122		209	209		153	153		49	49		7	7		565	565
Management Fee		80	80		122	122		209	209		153	153		49	49		7	7		620	620
TECHNICAL ADVISORS (STAP)		30	30		60	60		60	60		10	10		10	10		20	20		190	190
CONTRACTUAL SERVICES																					
- Environmental Monitoring		30	30		50	50		50	50		50	50		50	50		20	20		250	250
- Marketing Program		100	100		40	40											10	10		150	150
Sub-total - Contractual Services		130	130		90	90		50	50		50	50		50	50		30	30		400	400
ENERGY AUDITING SERVICES		8	8		22	22		16	16		4	4								50	50
EXTERNAL FINANCIAL AUDITING SERVICES		10	10		10	10		10	10		10	10		10	10		10	10		60	60
TRAINING & OTHER CONSULTING SERVICES		40	40		50	50		20	20		10	10		10	10		10	10		140	140
TOTAL TECHNICAL ASSISTANCE		298	298		354	354		365	365		237	237		129	129		77	77		1,460	1,460

Notes: /a GEF grant will cover 100% of local and foreign expenditures under the technical assistance. For this reason, it is shown as foreign cost.
/b Including Contractual Services
/c Equivalent to 2.3% of the GEF grant contribution for the investment component.

Project Costs - Total
(US$ thousand)

	1995			1996			1997			1998			1999			2000			TOTAL		
	L	F	T	L	F	T	L	F	T	L	F	T	L	F	T	L	F	T	L	F	T
INVESTMENT COMPONENT	481	519	999	4,798	4,574	9,373	11,196	10,261	21,456	7,403	6,579	13,985	588	455	1,043				24,466	22,388	46,856
TECHNICAL ASSISTANCE (incl. contractual services)		298	298		354	354		365	365		237	237		129	129		77	77		1,460	1,460
TOTAL COST	481	817	1,297	4,798	4,928	9,727	11,196	10,626	21,821	7,403	6,816	14,222	588	584	1,172		77	77	24,466	23,848	48,316
GEF GRANT FINANCING																					
INVESTMENT COMPONENT			615			4,994			11,044			7,260			627						24,540
TECHNICAL ASSISTANCE (incl. contractual services)			298			354			365			237			129			77			1,460
TOTAL AMOUNT: - annual			913			5,348			11,409			7,497			756			77			26,000
- cumulative			913			6,261			17,670			25,167			25,923			26,000			
- in % of total			3.5%			24.1%			68.0%			96.8%			99.7%			100.0%			

POLAND - COAL-TO-GAS CONVERSION PROJECT

Indicative Financing Plan
for Coal-to-gas Conversion Component

	As % of Project Cost		Technology: Cogeneration	Technology: High-Efficiency Boiler	TOTAL
Cost per project	100%	100%	5,099.8	403.5	
Average GEF Grant					
- Cogeneration System	60%		3,067.2		
- High-Efficiency Boiler System		34%		137.2	
Collateral Funding Required	40%	66%	2,032.6	266.3	
Indicative Collateral Financing Plan					
- National Fund/BOS	30%	40%	1,529.9	161.4	
- Voivodship	5%	16%	247.7	64.5	
- Minimum Owner's Contribution	5%	10%	255.0	40.4	
Possible Technology Mix					**TOTAL**
Number of projects			**6**	**38**	
Total Cost			30,599	15,332	45,931
of which:					
- GEF grant			18,403	5,212	23,615
- Collateral Funds			*12,196*	*10,120*	*22,316*
Indicative Collateral Financing Plan					
- National Fund/BOS					*15,313*
* Cogeneration System	30%		9,180		
* High-Efficiency Boiler System		40%		6,133	
- Voivodship/Other					*3,940*
* Cogeneration System	5%		1,486		
* High-Efficiency Boiler System		16%		2,454	
- Minimum Owners' Contribution					*3,063*
* Cogeneration System	5%		1,530		
* High-Efficiency Boiler System		10%		1,533	
Collateral Funding Required	*40%*	*66%*	*12,196*	*10,120*	*22,316*

Indicative Commitment Profile

Schedule for Approved GEF Projects	1995	1996	1997	TOTAL
* Cogeneration System	1	3	2	6
* High-Efficiency Boiler System	1	20	17	38
Annual Commitment Required for Approved GEF Projects				
* Cogeneration System	5,100	15,300	10,200	30,599
* High-Efficiency Boiler System	403	8,069	6,859	15,332
Total Commitment	5,503	23,369	17,059	45,931
Indicative Financing Requirements				
- GEF Contribution	*3,204*	*11,946*	*8,465*	*23,615*
- Collateral Funding				
* National Fund/BOS	1,692	7,817	5,805	15,314
* Voivodship/Other	312	2,034	1,593	3,939
* Minimum Owners' Contribution	295	1,572	1,196	3,063
Commitment from Collateral Funding	*2,299*	*11,423*	*8,594*	*22,316*

POLAND - COAL-TO-GAS CONVERSION PROJECT

Norwegian Co-financing

1. The Norwegian Government has allocated an additional grant of US$1.0 million to this project.

2. The Framework Convention on Climate Change (FCCC) was signed at the United Nations Conference on Environment and Development (UNCED) meeting in Rio de Janeiro in June 1992. Article 4.2(a) of the Convention states: "...These Parties may implement such policies and measures jointly with other Parties..." Article 4.2(d) states further: "..The Conference of the Parties, at its first session, shall also take decisions regarding criteria for joint implementation as indicated in subparagraph (a) above." The first session of the Conference of the Parties will take place within three months after the fiftieth country Party have ratified the Convention. This session is expected to take place in late 1994 or early 1995.

3. As the criteria of a joint implementation mechanism are yet to be developed and decided upon, no emission credits earned through this mechanism may be awarded under the FCCC.

4. Against this background, the Norwegian Government has expressed interest in supporting this GEF project, which may serve as a practical demonstration project for important elements of a joint implementation scheme under the FCCC.

5. The Ministry of Environmental Protection, Natural Resources and Forestry (MoEPNRF) and other participants were made fully aware that this project is not a joint implementation project under the FCCC and that no emission credits would be calculated or claimed as a part of this project. MoEPNRF expressed its interest in the exploratory nature of this GEF project and reaffirmed its understanding of the status of the project.

POLAND - COAL-TO-GAS CONVERSION PROJECT

Procurement Arrangements and Schedule

Procurement Arrangements

1. The prospective beneficiaries (boiler owners assisted with their Engineering consultants) would carried out the procurement of goods, works, materials, installation and services for individual projects under the supervision of the central office of the implementing agency, Bank Ochrony Srodowiska SA (BOS). That office would coordinate all procurement activities. It has qualified staff and the necessary office equipment, and it has received training in international procurement by specialized Bank staff. In addition, two of its staff would participate in the intensive training seminar on Equipment Procurement Management organized at the International Training Center of the International Labor Organization in Turin for new Bank borrowers and beneficiaries.

2. Each individual conversion project would involve several procurement sub-packages. Given the relatively low value of these sub-packages, they would be combined and procured on the basis of one Engineering, Procurement and Construction (EPC) contract per conversion project. The advantage of a single EPC contract is that it shifts responsibility for the entire project (mainly, the interface between sub-packages) to one construction contractor. It also permits well-coordinated project implementation. Suppliers of the combined procurement package would be post-qualified. Only single-stage bidding procedures would be followed under this project. However, a pre-bid conference would be required for all conversion projects.

3. In the absence of uniformly accepted public procurement rules and regulations in Poland, the Bank's standard bidding documents would be used for all GEF-financed components. Central BOS office would be responsible for ensuring that all procurements under this project follow Bank guidelines.

4. All procurement packages valued at US$300,000 and above would be procured through international competitive bidding (ICB) procedures in accordance with the Bank's Procurement Guidelines. In the evaluation and comparison of bids for equipment to be procured through ICB, Polish manufacturers would receive a domestic preference in the bid evaluation of 15 percent of the CIF price or the prevailing customs duty applicable to non-exempt importers, whichever is less, provided they can prove that the value added to the product in Poland exceeds 20 percent of the ex-factory bid price. All procurement for conversion projects involving cogeneration systems would follow ICB procedures. Goods and works procured through ICB would account for at least 75 percent of the goods and works requirements financed by the GEF and for at least 65 percent of the project fund. ICB procurement would consist of six EPC packages at an aggregate cost of US$29.1 million, of which US$16.9 million (or 58 percent) are the GEF-financed portion.

Tables 16-1 and 16-2 of this annex summarize the procurement arrangements and the procurement schedule for goods, works and services.

5. The exceptions to ICB procurement would be as follows:

(a) Limited International Bidding (LIB). This procedure would be used for individual conversion projects involving high-efficiency heat-only-boiler systems. Goods and works procured through LIB would account for at least 21 percent of goods and works requirements financed by the GEF, and for at least 18 percent of the project fund. LIB procurement would consist of 38 EPC packages at an aggregate cost of US$14.8 million, of which about US$4.7 million (or 31 percent) are the GEF-financed portion.

(b) Local Competitive Bidding (LCB). Unless stated otherwise, LCB procedure, acceptable to the Bank, would be used for the procurement of contractual services for the environmental monitoring and the marketing program. Contracts awarded under LCB procedure and discussed below shall not exceed an aggregate amount of about US$0.37 million equivalent:

(1) Environmental Monitoring. This would cover the contracting of the services for the pre- and post-conversion monitoring of the environmental and technical performance of individual projects approved for GEF financing. These services estimated to cost less than US$250,000 would be contracted into the two following contracts:

(i) Recognizing the critical need to collect environmental and technical data for the two pilot projects in Krakow during the 1994-95 winter heating season, ***a service contract valued at US$20,000*** would be awarded to a qualified contractor on a direct contracting basis. This contractor would collect the baseline monitoring data for the pilot projects and provide a standardized format for the collection of monitoring data to be used during the implementation phase of the project; and

(ii) ***A second service contract valued at US$230,000*** would be awarded to a single contractor following LCB procedure. This contractor would conduct the monitoring data collection activities during the implementation phase of the coal-to-gas conversion component of the project on the basis of a general work plan that would be reviewed annually and would focus on the collection of monitoring data for individual projects to be conducted on the basis of individual work orders.

(2) Marketing Program. This would cover the contracting of the services to implement the marketing plan developed by the

Ministry of Environmental Protection, Natural Resources and Forestry. This would include: (i) nationwide marketing program for the promotion of the GEF project concept, to be comprised of seminars, written advertising in relevant Polish magazines, radio and TV advertising, brochures, etc.; and (ii) post-conversion survey of completed GEF projects and collection of testimonials from boiler owners about their experience as beneficiaries of the GEF fund and as owners and operators of new gas-firing facilities involving high-efficiency heat technology. These services estimated to cost less than US$150,000 would be contracted into the following two contracts:

(i) For the nationwide marketing program ***a service contract valued at US$140,000*** would be awarded to a single contractor following LCB procedure; and

(ii) For the post-conversion survey ***a service contract valued at US$10,000*** would be awarded to a qualified contractor following direct contracting procedure.

(c) International Shopping (IS) and Local Shopping (LS). This procedure would be used for small amounts of equipment and materials such as heat control and measuring equipment and weatherization equipment, which are needed to increase the energy efficiency of new residential buildings. Contracts for equipment and materials estimated to cost less than US$300,000 per package would be awarded under IS procedure, based on comparing price quotations obtained from at least three eligible suppliers from at least three different countries. Contracts for equipment and materials estimated to cost less than US$50,000 per package would be awarded under LS procedure, based on comparing price quotations obtained from at least three qualified suppliers. Contracts for equipment and materials awarded under IS and LS procedures shall not exceed an aggregate amount of about US$1.0 million equivalent.

(d) Direct Contracting. This procedure would be used for items of a proprietary nature, or where compatibility with installed equipment is required.

(e) Technical Assistance Services. The technical assistance services, as discussed below, include BOS management fee, the services of the Scientific and Technical Advisory Panel (STAP), energy auditing, external financial auditing and consulting and training services. These services shall not exceed an aggregate amount of about US$3.13 million equivalent.

(1) BOS Management Fee. To cover its cost for administering the GEF project, BOS would receive a management fee equivalent to 2.5 percent (or US$620,000) of the GEF grant contribution for

the investment component of the project. The management fee would consist of start-up costs of US$55,000 for the first year of the project plus a performance-based management fee of US$565,000. The latter would be a function of BOS' ability to perform the list of activities necessary to implement this project successfully and would be calculated as 2.3 percent of the committed GEF grants for individual investment projects.

(2) Services of STAP. An amount of US$190,000 is budgeted for these services. It would cover the expenses (travel, subsistence and honoraria) of both the Polish and foreign members of the panel. Terms of reference (TORs) for STAP and a breakdown of the STAP budget are in Table 21-1 of Annex 21.

(3) Energy Auditing. A single-source contract for energy auditing valued at US$50,000 would be awarded to a consulting firm, acceptable to the Bank. This firm would assist BOS on matters related to the energy efficiency component (EE fund) of the project, including the energy audits and appraisals of new residential buildings that are applicants to the EE fund and the monitoring of results of completed projects financed from this fund.

(4) External Financial Auditing. A single-source contract for external financial auditing valued at US$60,000 would be awarded to an auditing firm, acceptable to the Bank. This firm would conduct financial audit of the records and accounts related to the Project Account, the Special Account and the Statement of Expenditures.

(5) Consulting Services and Training. (i) Qualified short-listed firms would be invited to submit proposals to provide consulting services in accordance with the Bank's Guidelines for the Use of Consultants. It is estimated that five contracts for services as boiler owners' representatives would be procured from consulting firms for an aggregate amount of US$2.07 million. To the extent practical, each contract would cover multiple boiler conversion projects. Standard TORs for the boiler owners' representatives have been developed and are in Annex 22; and (ii) As needed, the services of individual specialists, acceptable to the Bank, for consulting and training would also be contracted following direct contracting procedures. Individual contracts for these local specialists are estimated to cost less than US$5,000 with an aggregate amount of US$140,000. These specialists would be needed to assist BOS, the implementing agency, at various stages of project preparation, appraisal, implementation, monitoring and progress reporting. Standard TORs for these specialists have been developed and are in Annexes 23 and 24.

A procurement schedule for the various components under the technical assistance component, including procurement arrangements, is presented in Table 16-2 of this annex.

Procurement Review

6. ***For the procurement of goods and works***, the Bank would conduct a prior review of all ICB packages. In addition, the Bank's prior review would be required for the first three LIB packages and subsequent LIB packages would be subject to prior review of central BOS office. Other contracts would be subject to the Bank's ex-post reviews. Prior approval would be sought from the Bank for the use of the LIB, international and local shopping and direct contracting procurement methods. ***The procurement of all contractual services*** would be subject to the Bank's prior review. ***In the case of consulting services and training***, all TORs and selection procedures (including all single-source selection of consulting firms) would be subject to prior approval by the Bank, regardless of value. In addition, prior review would apply to all consulting contracts above US$100,000 (firms) and US$50,000 (individuals) and for amendments to consulting contracts that raise the contract value to US$100,000 or above for firms and US$50,000 or above for individual consultants. All assignments of a critical nature, as reasonably determined by the Bank, would also be subject to the Bank's prior review. The Bank's standard bidding documents would be used for ICB and LIB packages and for the recruitment of consultants, with such modifications thereto as the Bank shall have agreed to as necessary for purposes of the project.

POLAND - COAL-TO-GAS CONVERSION PROJECT

Procurement Arrangements
(US$ thousand)

PROJECT COMPONENTS	PROCUMENT METHODS /a				TOTAL
	ICB	LIB	LCB	OTHER /b	
GOODS, WORKS AND MATERIALS					
A. Cogeneration Systems	29,099 (16,903)				29,099 (16,903)
B. High Efficiency Boiler Systems		14,762 (4,642)			14,762 (4,642)
C. Energy Efficiency Equipment for New Residential Buildings				925 (925)	925 (925)
CONTRACTUAL SERVICES					
E. Environmental Monitoring			230 (230)	20 (20)	250 (250)
F. Marketing Activities			140 (140)	10 (10)	150 (150)
TECHNICAL ASSISTANCE					
G. BOS Management Fee				620 (620)	620 (620)
H. Technical Advisors (STAP)				190 (190)	190 (190)
I. Energy Auditing Services				50 (50)	50 (50)
J. External Financial Auditing Services				60 (60)	60 (60)
K. Training and Consulting Services				2,210 (2,210)	2,210 (2,210)
TOTAL	29,099 (16,903)	14,762 (4,642)	370 (370)	4,085 (4,085)	48,316 (26,000)

/a ICB: International Competitive Bidding; LIB: Limited International Bidding and LCB: Local Competitive Bidding.
Figures in bracket indicate amounts in US$ million equivalent to be financed from GET and Norwegian grants.

/b Includes:
(1) International & Local Shopping (aggregate amount US$0.93 million equivalent)
(2) Direct Contracting (aggregate amount US$0.03 million equivalent)
(3) Training & Consulting Services (aggregate amount US$3.13 million equivalent) awarded in accordance with Bank Guidelines for Use of Consultants.

POLAND - COAL-TO-GAS CONVERSION PROJECT

Procurement Schedule for Major Contracts

(Cost Estimates (in US$ thousand) and Procurement Methods)

Procurement Package Reference No.	Description of Procurement Contract Packages	Cost per Package	1995 Number of Packages	1995 Total	1996 Number of Packages	1996 Total	1997 Number of Packages	1997 Total	TOTAL Number of Packages	TOTAL Total
A. GOODS, WORKS AND MATERIALS										
A.1 INTERNATIONAL COMPETITIVE BIDDING (ICB)										
1 to 6	EPC Contracts for Cogeneration Systems	$4,850 ($2,817)	1	$4,850 ($2,817)	3	$14,550 ($8,452)	2	$9,700 ($5,634)	6	$29,099 ($16,903)
A.2 LIMITED INTERNATIONAL BIDDING (LIB), INTERNATIONAL SHOPPING (IS) AND LOCAL SHOPPING (LS)										
7 to 45	EPC Contracts for High Efficiency Boiler Systems	$388 ($122)	1	$388 ($122) (LIB)	20	$7,769 ($2,443) (LIB)	17	$6,604 ($2,077) (LIB)	38	$14,762 ($4,642)
46 to 58 /a	Energy Efficiency Equipment for New Buildings Buildings (insulation, exterior doors & windows, heating installation, etc.)		2 packs./IS 2 packs./LS	($250)	3 packs./IS 7 packs./LS	($475)	1 packs./IS 4 packs./LS	($200)	6 packs./IS 13 packs./LS	($925)

B. CONTRACTUAL SERVICES THROUGH LOCAL COMPETITIVE BIDDING (LCB)

		1994/95 Cost of Contract	
59	Environmental Monitoring	$230	($230)
60	Marketing Program	$140	($140)

C. CONSULTING SERVICES THROUGH SHORT LIST

Procurement Package Reference No.	Description of Procurement Contract Packages	1994 Number of Project Sites by Conversion Type: Cogeneration	1994 Condensing	1994 Contract Costs	1995 Number of Project Sites by Conversion Type: Cogeneration	1995 Condensing	1995 Contract Costs	1996 Number of Project Sites by Conversion Type: Cogeneration	1996 Condensing	1996 Contract Costs
I	Boiler Owner's Representative - Contract I	1	1	$265 ($265)						
II	Boiler Owner's Representative - Contract II				3		$750 ($750)			
III	Boiler Owner's Representative - Contract III					20	$300 ($300)			
IV	Boiler Owner's Representative - Contract IV							2		$500 ($500)
V	Boiler Owner's Representative - Contract V								17	$255 ($255)

Notes: Figures in bracket indicate GEF-financed portion.
Procurement schedule excludes contracts for goods, works and services awarded following direct contracting procedure.
/a The number of packages and the use of IS and LS procedures may vary depending on the size and geographical distribution of the residential buildings.

POLAND - COAL-TO-GAS CONVERSION PROJECT

Disbursement Schedule

Project Performance

1. The maximum total amount of the GEF grant assistance available for the coal-to-gas conversion activity is US$26.0 million, of which US$24.54 million are for the investment component. Potential coal-to-gas boiler conversion projects in Poland far exceed the GEF funds available. Even those limited GEF funds could, however, be significantly scaled down if only a few solid individual projects are identified and their counterpart financing secured within the first three years of the GEF project. About 13 percent of GEF project funds are already committed for the pilot projects in Krakow. To ensure satisfactory performance in project identification and appraisal and in the disbursement of GEF funds, targets for cumulative commitment levels for the GEF grant related to the investment component of the GEF project would be set as follows: (a) 14 percent (or about US$3.4 million) by the end of the first year; (b) 64 percent (or about US$15.7 million) by the end of the second year; and (c) 100% (or about US$24.5 million) by the end of the third year. Unless the Bank shall otherwise agree, the uncommitted portion of the overall GEF grant as of the beginning of the fourth year would then be canceled. Table 17-1 below summarizes the target levels of cumulative commitments by investment component.

Table 17-1: Targets for Cumulative Commitment Levels for GEF Fund

Project Components	End of First Year	End of Second Year	End of Third Year
A. Coal-to-gas Conversion			
- Annual	3,120	11,883	8,612
- Cumulative	3,120	15,003	23,615
- Percent	13%	64%	100%
B. Energy Efficiency Fund			
- Annual	250	475	200
- Cumulative	250	725	925
- Percent	27%	78%	100%
C. Total Investment Component			
- Annual	3,370	12,358	8,812
- Cumulative	3,370	15,728	24,540
- Percent	14%	64%	100%

Note: Amounts are in thousands of US dollars. The periods for reaching the targets for cumulative commitment levels of GEF fund would begin with the date of project effectiveness.

Disbursement Schedule

2. <u>Investment Component, Consulting Services and Training</u>. The disbursements schedule for the GEF grant is presented in <u>Table 17-2</u> of this annex. Given the requirement that the GEF funds be committed in the earlier phase of project implementation (see para. 1 above), the GEF disbursement profile differs from the Bank's disbursement profile for energy projects in the Europe and Central Asia Region.

3. For individual conversion projects, the GEF-financed portion would depend on site specifics and the conversion technology adopted. Typically, the GEF would finance about 34 percent of the cost of a high-efficiency boiler project and 60 percent of the cost of a cogeneration project. These ratios would be determined for each conversion project by the Bank Ochrony Srodowiska SA (BOS) and confirmed by the Scientific Technical and Advisory Panel (STAP). Prior approval by the Bank would be required for the financing ratios of all projects involving cogeneration systems and of the first three high-efficiency boiler projects. Financing ratios for subsequent high-efficiency boiler projects would be subject to prior approval by STAP. The share of GEF financing for energy efficiency equipment for new residential buildings would be subject to prior approval by STAP.

4. The proceeds of the GEF grant would be allocated as follows: (a) 100 percent of the GEF-financed portion of eligible direct foreign exchange expenditures for the supply and installation of equipment and materials; (b) 100 percent of the GEF-financed portion of eligible ex-factory costs of locally produced goods; (c) 100 percent of the GEF-financed portion of the local expenditures for the installation of equipment and materials; (d) 85% of the GEF-financed portion of local expenditures for items procured locally; and (e) 100% of foreign and local expenditures for contractual services, project administration fees, consulting services and training.

5. Disbursements for contracts valued at less than US$250,000 equivalent would be on the basis of statements of expenditures that detail individual transactions. BOS would retain the documentation to support these expenditures. This documentation would be audited by independent auditors and made available to the Bank for review upon request. Applications for withdrawals against contracts valued at more than US$250,000 equivalent would be fully documented. To facilitate disbursements, BOS would establish an US dollar denominated Special Account.

6. Given that most of the equipment and materials would be procured following ICB procedure and that a large share of the consulting services would be procured from qualified short-listed firms, the authorized allocation of the Special Account would be US$500,000. Replenishment applications should be for amounts of not less than US$100,000.

7. **BOS Management Fee**. To cover its cost for administering the GEF project, BOS would receive a management fee equivalent to 2.5 percent (or US$620,000) of the estimated GEF grant contribution of US$24.54 million for the investment component of the project. The management fee would consist of start-up costs of US$55,000 for the first year of the project plus a performance-based management fee of US$565,000. The latter would be a function of BOS' ability to perform the list of activities necessary to implement this project successfully and would be calculated as 2.3 percent of the committed GEF grants for individual investment projects. ***For individual coal-to-gas conversion project***, the management fee could be disbursed as follows: (a) 30 percent of the fee would be paid once the financing for the individual project is committed; (b) 40 percent would disbursed upon award and signature of the engineering, procurement and construction contract; (c) 25 percent would disbursed upon satisfactory project commissioning and turnover of the new facility to the owner; and (d) the remaining 5 percent would be disbursed upon satisfactory completion of a technical and environmental performance monitoring report of the individual project. ***For individual energy efficiency project***, the management fee could be disbursed as follows: (a) 70 percent of the fee would be disbursed upon award and signature of the equipment supply contract; and (b) 30 percent would be disbursed upon satisfactory completion of a performance monitoring report of the individual project. The management fee shall be payable semi-annually for each semester ending November 30 and May 31 in each fiscal year. The fee would be paid in the aggregate based on the status of individual projects at the time the amount of the management fee is calculated.

POLAND - COAL-TO-GAS CONVERSION PROJECT

Disbursements Schedule
(US$ thousand)

IBRD Fiscal Year	SEMESTER ENDING	WITHDRAWALS		DISBURSEMENT PROFILE	
		AMOUNT	CUMULATIVE	PROJECT	STANDARD /a
1995	December 31, 1994	0	0	0.0%	0.0%
	June 30, 1995	457	457	1.8%	3.0%
1996	December 31, 1995	456	913	3.5%	10.0%
	June 30, 1996	2,674	3,587	13.8%	18.0%
1997	December 31, 1996	2,674	6,261	24.1%	26.0%
	June 30, 1997	5,705	11,966	46.0%	46.0%
1998	December 31, 1997	5,704	17,670	68.0%	54.0%
	June 30, 1998	3,749	21,419	82.4%	70.0%
1999	December 31, 1998	3,748	25,167	96.8%	90.0%
	June 30, 1999	378	25,545	98.3%	94.0%
2000	December 31, 1999	378	25,923	99.7%	98.0%
	June 30, 2000	77	26,000	100.0%	100.0%

/a Bank's standard disbursement profile for the energy sector in Europe and Central Asia Region, issued on August 1993.

POLAND - COAL-TO-GAS CONVERSION PROJECT

Project Implementation Plan

1. Project Implementation Schedule. The project would be implemented during FY1995-2000. The project's completion date is expected to be June 30, 2000 and the closing date December 31, 2000. Typical project implementation schedules for the main investment component (conversion projects involving cogeneration and high-efficiency boiler technologies) are shown in Tables 18-1 and 18-2 of this annex. To reach the targets for commitment levels for the GEF grant (see para 1 of annex 17) the appraisal schedule for follow-up projects, as presented in Table 18-3 below, needs to be followed.

Table 18-3: Appraisal Schedule for Follow-up Projects

INVESTMENT COMPONENTS		Number of Individual Projects			
		End of First Year	End of Second Year	End of Third Year	TOTAL GEF PROJECT
A.	Coal-to-Gas Conversion Component				
	- Cogeneration Systems	1	3	2	6
	- High-Efficiency Boiler Systems	1	20	17	38
B.	Energy Efficiency Component				
	- New Residential Units a/	180 - 216	342 - 411	144 -173	666 - 800

Note: a/ Depending on the energy efficiency and conservation measures considered, the number of units would vary within the specified ranges of values.

2. Project Auditing Requirements. The Project Account, the Special Accounts, and the Statement of Expenditures would be audited at the end of each fiscal year in accordance with international standards. Agreement was reached that Bank Ochrony Srodowiska SA (BOS) would appoint independent external auditors acceptable to the Bank and present, within six months after the end of each fiscal year, the audited Project Account, Special Account and Statement of Expenditures.

3. Project Monitoring and Reporting Requirements. Systems and procedures would be set up to ensure effective supervision and monitoring of project implementation by the Recipient the Ministry of Environmental Protection, Natural Resources and Forestry (MoE), the implementing agency BOS, and the Bank. In particular, BOS would furnish to MoE and the Bank regularly a series of reports. Very close attention would be paid to identification and appraisal of follow-up conversion projects and projects for energy efficiency in buildings, the procurement and disbursement process, project implementation and the monitoring of the technical and environmental performance of completed projects. For each individual project financed from the GEF fund, MoE and BOS would report on selected key variables and other statistical information that would be monitored

POLAND - COAL-TO-GAS CONVERSION PROJECT

Typical Implementation Schedule for Replacement of Existing Coal-fired Boiler(s) with High-Efficiency Gas-fired Boiler(s)

- PLANNING, ENGINEERING DESIGN AND PROCUREMENT -

This project schedule utilizes direct contracting procedure for the services of a boiler owner representative and limited international bidding procedures for the engineering, procurement and construction (EPC) contractor. If a single owners representative contract and/or a single EPC contractor to service multiple boiler projects are preferred, the procurement schedule should follow the Bank's selection procedures for consultants for the Owners Representative and the international competitive bidding procedures for the EPC contractor, as shown in the schedule for the combined heat and power project.

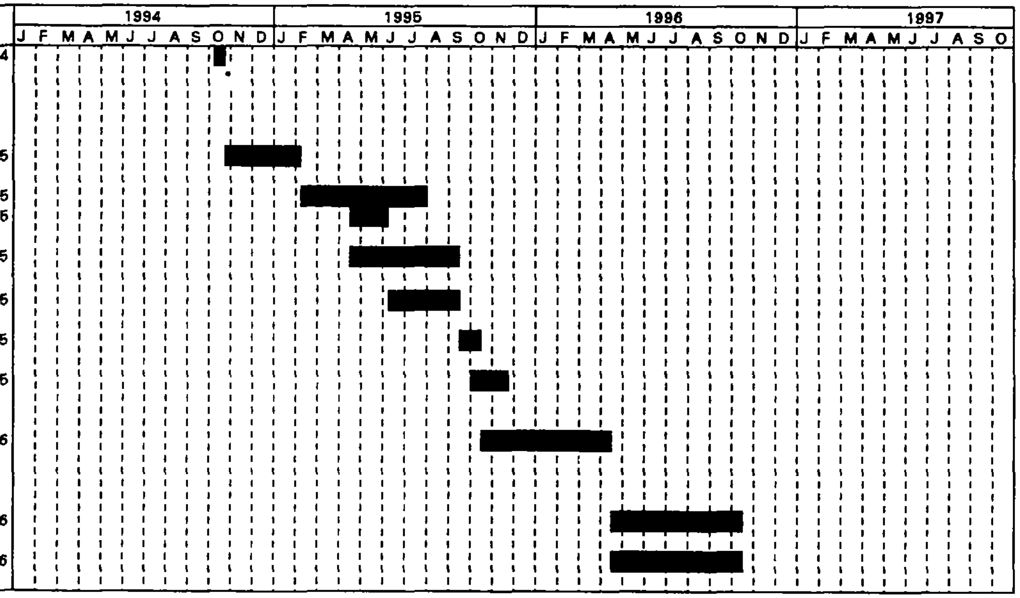
Task name	Start Date	End Date
Project approval	1-Mar-94	
Select and engage boiler owner representative	14-Mar-94	29-Apr-94
Boiler owner prepares terms of reference and selection procedure for direct contract	14-Mar-94	1-Apr-94
Review and approval of terms of reference and procurement procedures by IBRD	3-Apr-94	15-Apr-94
Formulate and sign contract with boiler owner representative *Contract becomes effective*	18-Apr-94	29-Apr-94
Mobilization of boiler owner representative	2-May-94	13-May-94
Collection of ambient air quality data, where monitoring systems have been established	4-Apr-94	11-Apr-97
Preconversion environmental and technical performance monitoring during boiler operation	15-Oct-94	15-Apr-95
Planning, scheduling, engineering, cost estimating	16-May-94	15-Jul-94
Boiler owner review and approval of plans, cost estimates, schedule	18-Jul-94	29-Jul-94
Select and engage EPC contractor following LIB procedure	18-Jul-94	7-Oct-94
IBRD review and clearance for EPC contractor specifications and bidding documents	18-Jul-94	4-Aug-94
Issuance of invitation to bid	5-Aug-94	
Preparation and submission of bids	6-Aug-94	6-Sep-94
Boiler owner evaluates bids and prepare bid evaluation report	6-Sep-94	20-Sep-94
IBRD review of bid evaluation report and approval of award recommendation	20-Sep-94	28-Sep-94
Signing of EPC contract and EPC contract *becomes effective*	28-Sep-94	7-Oct-94

POLAND - COAL-TO-GAS CONVERSION PROJECT

Typical Implementation Schedule for Replacement of Existing Coal-fired Boiler(s) with High-Efficiency Gas-fired Boiler(s)

- CONSTRUCTION WORK, EQUIPMENT INSTALLATION, AND COMMISSIONING -

Task name	Start Date	End Date
EPC contractor mobilization	10-Oct-94	21-Oct-94
EPC contractor begins work	24-Oct-94	
Detailed design, plans, final review of specifications & schedule, procurement contracting for materials, supplies, services and equipment	24-Oct-94	3-Feb-95
Contracting for and delivery of equipment, services, materials and supplies	6-Feb-95	30-Jul-95
Remove old equipment, site modification for new equipment	17-Apr-95	2-Jun-95
Rehabilitation/upgrade of heat distribution system and buildings served	17-Apr-95	15-Sep-95
Install equipment, connect to gas systems, acceptance testing	5-Jun-95	15-Sep-95
Commissioning, training of boiler owners staff, acceptance completed	18-Sep-95	13-Oct-95
Site cleanup, painting & refurbishing, removal of temporary facilities and construction equipment	2-Oct-95	24-Nov-95
One year of post-conversion environmental and technical performance monitoring (during boiler operation)	16-Oct-95	15-Apr-96
Prepare and issue project pre- and post-conversion environmental and technical performance monitoring report	16-Apr-96	16-Oct-96
Prepare project completion report	16-Apr-96	16-Oct-96



Note 1. Significant reductions in project schedule and improvements in contractor efficiency and reduction in cost of services should be possible if arrangements could be made for having a single owners representative and a single EPC contractor for multiple sequenced projects.

Note 2: Owner representative should give particular attention to the need for adequate time for delivery of long lead time equipment.

Note 3: Policy in Poland does not permit work other than emergency maintenance on heating boilers or distribution system during the heating season, which is October 15 - April 15. Dates could be shifted as long as the implementation schedule complies with this policy and with the Bank's requirements for international procurement procedures.

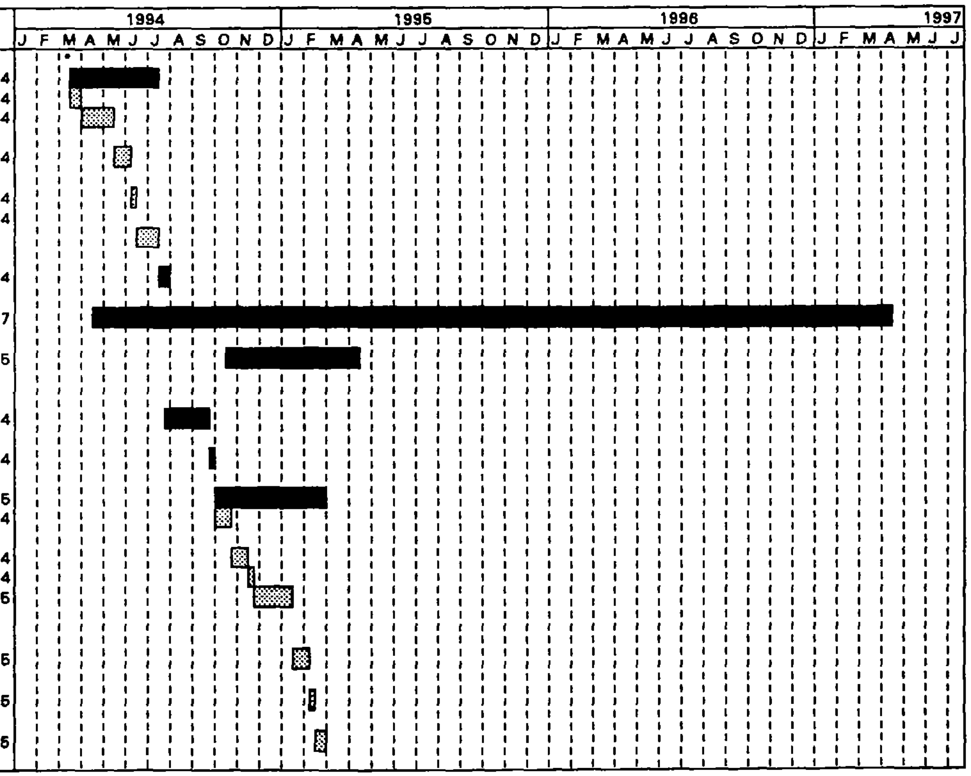
POLAND - COAL-TO-GAS CONVERSION PROJECT

Typical Implementation Schedule
for
Replacement of Existing Coal-fired Boiler(s) with Gas-fired Combined Heat and Power System

- PLANNING, ENGINEERING DESIGN AND PROCUREMENT -

This project schedule utilizes sequential contracting for the services of a boiler owner representative and for the engineering, procurement and construction (EPC) contractor, following competitive bidding procedures in accordance with the Bank Guidelines for the Procurement of Goods, Works and Services.

Task name	Start Date	End Date
Project approval	1-Mar-94	
Select and engage boiler owner representative	14-Mar-94	15-Jul-94
Prepare and issue letter of invitation to bid	14-Mar-94	25-Mar-94
Preparation and submission of proposals	28-Mar-94	13-May-94
Boiler owner evaluates proposals and *prepares bid evaluation and report*	16-May-94	3-Jun-94
IBRD review of evaluation report and approval of award recommendation	6-Jun-94	17-Jun-94
Announce award, formulation & signing of contract Contract becomes effective	20-Jun-94	15-Jul-94
Mobilization of boiler owner representative	18-Jul-94	29-Jul-94
Collection of ambient air quality data, where monitoring systems have been established	11-Apr-94	11-Apr-97
Preconversion environmental and technical performance monitoring during boiler operation	15-Oct-94	15-Apr-95
Planning, scheduling engineering, cost estimating and preparing specifications by owner representative	25-Jul-94	23-Sep-94
Boiler owner review and approval of project plans, cost estimates, specifications, etc...	26-Sep-94	30-Sep-94
Select and engage EPC contractor following ICB procedure	1-Oct-94	27-Feb-95
Prepare specifications for EPC contract	1-Oct-94	21-Oct-94
IBRD review and clearance for EPC contractor specifications and bidding documents	24-Oct-94	11-Nov-94
Issue invitation to bid	14-Nov-94	18-Nov-94
Preparation and submission of bids	21-Nov-94	13-Jan-95
Bid opening	16-Jan-95	
Boiler owner evaluates bids and prepares bid evaluation report	17-Jan-95	3-Feb-95
IBRD review bid evaluation report and *approval of award recommendation*	6-Feb-95	17-Feb-95
Signing contract and *EPC contract becomes effective*	20-Feb-95	27-Feb-95



POLAND - COAL-TO-GAS CONVERSION PROJECT

Typical Implementation Schedule for Replacement of Existing Coal-fired Boiler(s) with Gas-fired Combined Heat and Power System

- CONSTRUCTION WORK, EQUIPMENT INSTALLATION, AND COMMISSIONING -

Task name	Start Date	End Date
EPC contractor mobilization	27-Feb-95	10-Mar-95
EPC contractor begins work	10-Mar-95	
Detailed design, plans, final review of specifications & schedule, procurement, and delivery of materials, supplies, services and equipment	11-Mar-95	31-Aug-95
Boiler owner monitoring of construction contract	16-Mar-95	22-Dec-95
Remove old equipment, site modification for new equipment	17-Apr-95	2-Jun-95
Rehabilitation/upgrade of heat distribution system and buildings served	16-Mar-95	13-Oct-95
Install CHP plant equipment, commissioning, connect to gas and electricty systems, acceptance testing, training owner O&M staff	5-Jun-95	22-Dec-95
Site cleanup, painting & refurbishing, removal of temporary facilities and construction equipment	2-Oct-95	24-Nov-95
One year of post-conversion environmental and technical performance monitoring (during boiler operation)	16-Oct-95	15-Apr-96
Prepare and issue project pre- and post-conversion environmental and technical performance monitoring report	16-Apr-96	16-Oct-96
Prepare project completion report	16-Apr-96	16-Oct-96

Note 1: Significant reductions in project schedule and improvements in contractor efficiency and reduction in cost of services should be possible if arrangements could be made for having a single owners representative and a single EPC contractor for multiple sequenced projects.

Note 2: Owner representative should give particular attention to the need for adequate time for delivery of long lead time equipment.

Note 3: Policy in Poland does not permit work other than emergency maintenance on heating boilers or distribution system during the heating season, which is October 15 - April 15. Dates could be shifted as long as the implementation schedule complies with this policy and with the Bank's requirements for international procurement procedures.

POLAND - COAL-TO-GAS CONVERSION PROJECT

Supervision Action Plan

IBRD FISCAL YEAR	STAFFING REQUIREMENT		STAFF WEEKS TOTAL	STAFF WEEKS Of which Field
1995	Task Manager		5	3
	Cogeneration/Boiler Specialist		5	3
	Energy Efficiency Specialist		4	3
	Environmental Specialist		3	1
	Procurement Specialist		2	1
	Sub-total - FY95		19	11
	Number of Supervision Mission	*3*		
	Number of weeks per mission	*1*		
1996	Task Manager		5	3
	Cogeneration/Boiler Specialist		5	3
	Energy Efficiency Specialist		4	3
	Environmental Specialist		3	1
	Procurement Specialist		2	1
	Sub-total - FY96		19	11
	Number of Supervision Mission	*3*		
	Number of weeks per mission	*1*		
1997	Task Manager		5	3
	Cogeneration/Boiler Specialist		5	3
	Energy Efficiency Specialist		4	3
	Environmental Specialist		3	1
	Procurement Specialist		2	1
	Sub-total - FY97		19	11
	Number of Supervision Mission	*3*		
	Number of weeks per mission	*1*		
1998	Task Manager		3	1
	Cogeneration/Boiler Specialist		3	1
	Energy Efficiency Specialist		2	1
	Environmental Specialist		3	1
	Procurement Specialist		1	
	Sub-total - FY98		12	4
	Number of Supervision Mission	*3*		
	Number of weeks per mission	*1*		
1999	Task Manager		3	1
	Cogeneration/Boiler Specialist		2	1
	Energy Efficiency Specialist		2	1
	Environmental Specialist		3	1
	Procurement Specialist		1	
	Sub-total - FY99		11	4
	Number of Supervision Mission	*2*		
	Number of weeks per mission	*1*		
2000	Task Manager		3	1
	Cogeneration/Boiler Specialist		2	1
	Energy Efficiency Specialist		2	1
	Environmental Specialist		3	1
	Sub-total - FY2000		10	4
	Number of Supervision Mission	*2*		
	Number of weeks per mission	*1*		
	TOTAL		90	45

POLAND - GEF COAL-TO-GAS CONVERSION PROJECT

Financial Analysis

PART A. MARGINAL COST ANALYSIS - DEFINITIONS AND METHODOLOGY

Determination of the GEF Contribution

1. The GEF project aims at providing incentives to boiler owners to convert from coal-firing to gas-firing. It would provide grant funding equivalent to the incremental life-cycle costs of converting existing coal-fired boilers to gas-firing (the GEF project case) over the alternative option of continuing to operate appropriately rehabilitated or new coal-fired plants (the reference case). For this purpose, the internal rate of return (IRR) is used as a measure of the boiler owner's acceptance of the GEF conversion proposal. The GEF contribution is determined using an incremental cash-flow analysis over the project's economic lifetime. It represents the capital subsidy required to bring the rate of return on the boiler conversion up to the boiler owner's required IRR.

Incremental Analysis

2. Selection of the Reference Project. The boiler conversion/technology modifications to be financed under this project would not occur under present economic circumstances and national/local incentive structure. From the boiler owner's point of view, such modification would not be financially attractive without concessional funding. Determination of the GEF capital subsidy raises the issue of selecting a reference case. This case should correspond to what the boiler owner should do without the GEF capital subsidy and without taking into account global consideration in the project evaluation. The incremental analysis, including the selection of the reference case, should be carried out on the basis of the regulation and economic conditions prevailing in Poland at the time the analysis is carried out. These factors will evolve over time. [1/]

3. The main criterion to select the reference case was the age of the boilers. Given the low level of environmental levies and the present shortage of local funding, the incentive for the boiler owner is to keep existing old boiler units in operation, at increasingly higher operating and maintenance costs. Once the age of the existing boiler unit is such that its continued operation is no longer financially justified, the preferred investment alternative is to replace the existing boilers with new coal-fired boiler. This decision is more justified because the present levels of energy prices and environmental fees do not yet

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[1/] For example, tightening and enforcement of the environmental standards for local air pollution from low-level emission sources will make some privately non-profitable boiler conversions profitable.

provide incentives for fuel switching. For the purposes of the financial analysis, it was assumed that the age limit at which replacement with a new coal-fired unit would be warranted is 25 years.

4. The energy efficiency and conservation measures were assumed to apply to both the GEF project and reference cases, as follows. The boiler owners would replace old boilers after 25 years in service with new coal-fired boilers, and would re-engineer the installation to take advantage of privately energy-efficient improvements. The investment costs for these improvements can be financially justified by: (a) the reduction in the investment cost for new boilers, since the capacity of the replaced boiler is downsized; and (b) the reduction in annual fuel and maintenance costs. At Jana Street, the payback period for these improvements would be four years, equivalent to a rate of return of 23 percent; at the Polytechnic University, the payback period would be three years, equivalent to a rate of return of 34 percent. Thus, the impact of these conservation measures on global warming would not appear directly in the incremental analysis. However, it would appear in the overall benefits of the GEF project compared with existing boiler facilities.

5. Project Incremental Cash Flow. *Incremental Operating Cash Flows.* Since the GEF project case and the reference case have the same benefits over the planning period considered -- as they both deliver the same amount of useful energy for heating -- operating revenues would be equal in both cases. Further, from the boiler owner's point of view, the GEF project case with the GEF capital subsidy and the reference case should produce the same income flows and not bear any tax consequences. On this basis, the incremental analysis was carried out on a pre-tax basis. Thus, the incremental operating cash flows represent the savings in annual operating costs (see para. 7 below). The planning period is assumed to be 17 years (the economic lifetime of the boiler), although the boilers could be technically operated for a longer period, but at increasingly higher operating costs.

6. *Incremental Capital Investment Costs.* The incremental capital investment costs are calculated by taking the difference between the present values of annual capital investment costs in both the GEF project and reference cases, using the boiler owner's required IRR as the discount rate (see para. 8 below).

7. Annual Operating Costs. The annual operating costs consist of the following: fuel; maintenance (services and spare parts); labor; and environmental fees. In the case of cogeneration technology, electricity generation is an additional benefit to the generation of heat. This benefit would be evaluated by using an average price between the selling and purchasing prices for electricity. Revenues from electricity generation would be deducted from the GEF project annual operating costs.

8. Investment Costs. The investment costs include five major components: (a) the new heat facilities; (b) supplementary end-user efficiency and conservation measures in existing buildings supplied by the boilers; (c) connection to the gas and electricity networks; (d) provisions for demolition and safe removal of existing facilities; and (e) engineering and project management services

(engineering consultants acting as boiler owner representatives). All investment costs include a physical contingency of 10 percent and a price contingency of 2.5 percent compounded annually.

9. Project Implementation. The following project implementation period was also taken into account in the analysis: (a) one year for the condensing boiler technology; and (b) two years for the cogeneration unit, with 25 percent of the work occurring in the first year and 75 percent in the second year. The works for the reference case were assumed to take less than a year.

10. Taxes. Taxes on fuels, labor and equipment have been added. The heat produced in the cogeneration facility at the Polytechnic University would be consumed by the University or sold to the Senior Citizen Home at cost. In the latter case, no tax on profits would be paid. Grant-financed investments are exempt from custom duties and import taxes.

11. Determination of the Grant. The GEF capital subsidy is equal to the net present value of the incremental cash flows discounted at the boiler owner's required IRR.

PART B. INPUT DATA AND ASSUMPTIONS

Worksheet Model for Economic and Financial Analysis

12. The amount of GEF grant-financing and the reduction of carbon dioxide (CO_2) emissions was determined using a user-friendly, menu-driven worksheet model. The Bank prepared this model for analyzing the economic and financial viability of conversion projects. The two pilot projects in Krakow provided the basic framework of analysis. The model covers the economic and financial analysis, including cash flow projection, projected rates of return and determination of the GEF contribution and of the environmental benefits (local and global). The Bank provided an electronic copy of this model, with its user manual, to the Ministry of Environmental Protection, Natural Resources and Forestry (MoE) and the Bank Ochrony Srodowiska SA (BOS). Given the continuous changes in energy prices and other operating costs, regular updates of this model would be required. MoE and BOS have assigned qualified staff to perform GEF incremental analysis using this model. The methodology underlying this model was described in Part A of this annex. The assumptions are presented below.

Operating Costs

13. Fuels. *Coal*. The calorific values and prices of coal and coke vary with the site and season of the year. In Krakow, low-sulfur coal or coke are used. At Jana Street, coke is used (calorific value of 30 Gigajoule per ton (GJ/ton), with a sulfur content of 0.4 percent and ash content of 10 percent) and its average price is US$72/ton. The boilers at Warszawska Street are fuelled with coal (calorific value of 24.3 GJ/ton, with a sulfur content of 0.8 percent and ash content of 10 percent), priced at US$60/ton.

14. *Gas*. The calorific value of the gas used is 34,300 kilojoule per normal cubic meter (kJ/Nm^3). Gas is priced on the basis of a two-part tariff system: a quarterly fixed charge based on capacity demand and a variable charge based on actual consumption. Given the estimated capacity and volume of gas required at the new facilities, the average prices of gas would be about US¢17.1 per Nm^3 at Jana Street and US¢14.6 per Nm^3 at Warszawska Street. An additional 7 percent value-added tax (VAT) would apply to the coal and gas prices.

15. *Light Fuel Oil (LFO)*. LFO would be used as a back-up fuel and for peak shaving of gas demand. Its calorific value is 41 GJ/ton. The price of LFO with 1 percent sulfur content is US$403/ton, inclusive of a 30 percent turnover tax.

16. **Electricity**. The Ministry of Finance sets the tariffs for electricity. The Polytechnic Institute is charged US$78 per Megawatthour (MWh) for its own consumption, with no charge for capacity. The Ministry of Industry sets the price distribution companies pay to purchase of power from independent producers. Currently this price is US$28.2/MWh. It is estimated that one-third of the electricity produced in the new cogeneration unit would be used at the Polytechnic University, and the remaining two-thirds would be sold to the electrical grid. Therefore, the electricity cogenerated at the Polytechnic University can be valued at US$45/MWh.

17. **Labor**. The data on salaries were provided by boiler owners. They included taxes of 20 percent and social charges of 45 percent. The average salaries excluding taxes are US$900/man-year at Warszawska Street and US$1,650/man-year at Jana Street. Boiler conversion would significantly reduce the manpower requirements from the present levels of 23 man-years at Warszawska Street and 9 man-years at Jana Street to expected levels of 5 and 1 man-years, respectively.

18. **Maintenance**. Annual maintenance costs include spare parts and services. These were evaluated as a percent of investment costs: (a) 6 percent for coal-fired boilers; (b) 3 percent for gas-fired boilers; and (c) 3 percent for other capital investments. For the cogeneration units, the maintenance cost is estimated at US$12/MWh-electric. The taxes on maintenance consist of a 22 percent VAT on equipment (for spare parts).

19. **Environmental Fees**. The fees applicable in Poland for this type of installation are: (a) US$73/ton for sulfur dioxide (SO_2); (b) US$36/ton for particulates; and (iii) US$73/ton for nitrogen oxides (NOx). There is also a small fee of US¢6.0 per ton for CO_2 .

20. **SO_2 and Particulates Emissions**. For SO_2 emissions, it is estimated that 20 percent of the sulfur remains in the slag. Dust emissions are calculated from the ash content of the coal, assuming that 20 percent of the ash is emitted and taking into account the efficiency of existing dust-removal devices. For example, the chimneys at Warszawska Street are equipped with filters that have a 60 percent efficiency.

21. **NOx Emission**. Standard NOx emissions are expressed as a function of the heat produced, using the following emission factors for various heat supply

technologies: (a) 42 kg/100 MWh for coal boilers; (b) 9 kg/100 MWh for gas boilers; and (c) 55 kg/100 MWh for gas turbines.

22. Emissions from Power Plants. These were estimated from a database on power plants in Poland. The average efficiency of power generation in the national power system (including combined heat and power plants) is 34 percent. Average emissions are expressed as a function of the electricity produced, using the following emission factors: (a) 13 kg/MWh for SO_2; (b) 4.8 kg/MWh for fly ash; (c) 1.1 kg/MWh for NOx; and (d) 974 kg/MWh for CO_2.

23. Greenhouse Gas Emissions. To assess CO_2 emissions from the fuel used, the following standard emission factors were used: (a) 92 kg/GJ for coal; (b) 53 kg/GJ for gas; and (c) 77 kg/GJ for LFO. Emissions of methane from pipeline leakage was not considered in the analysis. Methane gas has a global warming potential value of 21 relative to CO_2, on a mass basis and over a 100-year time horizon (see para. 31 below).

24. Inflation and Price Escalation. The projected cash flows are in nominal terms, using a 2.5 percent annual inflation rate. Since a boiler owner's decision to convert would be made on the basis of the present incentive structure and current conditions in Poland, only prices prevailing at the time the analysis is made were used. No real price increase for operating costs has been considered in the analysis.

PART C - DETERMINATION OF THE GEF GRANT

25. The marginal costs analyses for the two pilot projects in Krakow are presented in Tables 19-1 and 19-2 of this annex. Both incremental analyses show that the conversion to gas using higher efficiency technology is not financially viable. The IRRs in both cases are negative. To achieve a 25 percent IRR, GEF should grant finance about 34 percent (or US$130,000) and 60% (or US$2.94 million) of the individual project costs at Jana Street (US$385,000) and Warszawska Street (US$4.86 million), respectively.

PART D. PROJECT BENEFITS

Reduction in Global Warming

26. The main global environmental benefit of this project is a reduction in CO_2 emissions as a result of the switch from coal to gas. The annual reductions have been estimated based on operational data for both the GEF and conventional options. Secondary effects on global warming have been identified but were not included in the analysis.

27. Reduction in CO_2 Emissions. For both the reference and the GEF project cases, CO_2 emissions were estimated based on: (a) annual heat demand (which is the same for the GEF project and reference cases); (b) efficiency of heat supply

facilities (coal-fired boilers, gas-fired condensing boilers or cogeneration units); (c) unit emission factors for gas, LFO and coal; and (d) share of heat produced by the cogeneration unit and the peak boilers. Additional CO_2 emission credits were attributed to the cogeneration units, resulting from the displacement of the electricity now generated from coal in the national power system at 34 percent efficiency.

28. Compared with the reference case (new coal-fired boilers), CO_2 emissions could be reduced by 6,168 tons per year (or about 57 percent) at Warszawska Street and by 494 tons per year at Jana Street (or 51 percent). Compared with the old boiler facilities, these reductions are larger and amount to 8,843 tons per year at Warszawska Street (or 66 percent) and 1,210 tons per year at Jana Street (or 71 percent).

29. **Secondary Effects on Global Warming**. The secondary effects on global warming, as discussed below, would include: (a) a reduction in emissions of NOx, carbon monoxide (CO) and non-methane volatile organic compounds (NMVOC) resulting from incomplete combustion of coal pyrolysis products in the existing inefficient coal-fired boilers; (b) an increase in methane emissions as a result of leakage from gas pipelines; (c) a decrease in the methane emissions associated with coal-mining; and (d) effects on other greenhouse gas emissions associated with equipment construction, coal distribution, etc., which are likely to be negligible.

30. Reduction in NOx, CO and NMVOC. NOx, CO and NMVOC are themselves insignificant as greenhouse gases because of their short atmospheric lifetimes, but through their chemical reactions with each other and with other substances in the atmosphere, they are precursors to ozone formation in the troposphere (atmosphere region below the stratosphere). Tropospheric ozone is recognized as a significant greenhouse gas and it is known to have a significant lifetime in the troposphere. However, ozone itself is chemically reactive and it is only a stage in a continuing chain of complex chemical reactions in the troposphere which is still being studied. Further, the non-uniform distribution of these gases in the troposphere complicates the analysis of their secondary effects. For all these reasons, the Inter-Governmental Panel on Climate Change (IPCC) notes that it may be inappropriate to assign secondary global warming potential values to these ozone precursor gases; and for now, according to the 1992 IPCC latest findings that are published [2/], IPCC believes that not enough is known regarding the long term effects of tropospheric ozone to assign even a trend (increasing or decreasing) to the secondary global warming potential of ozone precursors. CO would oxidize to CO_2 but the impact of the modest quantity of CO emissions would be very small.

2/ Sources:
(a) "1992 IPCC Supplement - Scientific Assessment of Climate Change," Submission of Working Group #1, Intergovernmental Panel on Climate Change, February 1992
(b) "Climate Change 1992 - The Supplementary Report to the IPCC Scientific Assessment," by J.T. Houghton, B.A. Callander and S.K. Varney, 1992

31. Increase in Methane Emissions from Pipeline Leakages. The evaluation of methane emissions from pipeline leakages would require data on the origin and composition of the gas, the leakage rates in the gas transmission and distribution networks and the gas pressure reduction stations, and unaccounted losses from the imprecision of the meters. Since these data were not available, a break-even analysis was carried out. Based on a combined direct and indirect global warming potential value of 21 (IPCC, 1990) for a pulsed emission of methane evaluated over a 100-year time horizon relative to the emission of the same weight of CO_2, the equivalent quantity of methane leakage in the gas systems that would offset the calculated 10,050 metric tons per year of CO_2 reduced by the two pilot projects in Krakow would approximate 670,000 Nm^3 per year. The break-even leakage quantity would be about: (a) 27 percent of the annual estimated consumption of methane for the two pilot projects after conversion, which is about 2,495,000 Nm^3 per year without leakage; or (b) 21 percent of the combined methane consumption and hypothetical break-even leakage quantity of 3,165,000 Nm^3. These calculations are based on pure methane. Natural gas is not pure methane and the actual leakage and consumption of methane would be modestly higher, depending on the specific composition of the natural gas supplied.

32. Reduction in Methane Emissions from Coal Mining. The reduction in methane emissions from coal-mining operations could bring significant additional global benefits but were not estimated because of a lack of data and clear methodology.[3/]

Local Environmental Benefit

33. In addition to the global benefit of CO_2 emission reductions, this project would result in an improvement in the quality of air locally by decreasing the emissions of pollutants such as dust, SO_2 and NOx. The pilot projects in Krakow would eliminate the use of about 4,238 tons of coal or coke per year. This would reduce the annual emissions of SO_2, NOx, and particulates in the Krakow region by about 46 tons, 3.7 tons, and 52 tons, respectively. On a national basis, the displacement of electricity now produced in coal-fired power plants by the cogeneration unit at Polytechnic University would further reduce emissions of SO_2, NOx, and particulates by about 72 tons, 5.8 tons and 26.4 tons, respectively.

3/ Methane releases from underground mining operations in the U.S. range from as low as about 6 to as high as about 70 m^3 per ton of coal mined (see source below). If similar methane emissions from underground coal mining operations prevailed in Poland, this would translate into a reduction of methane emissions from coal mining from about 25,000 m^3 per year to possibly as much as 296,000 m^3 per year for the pilot projects in Krakow.

Source: "Methodologies for Greenhouse Gas Emissions," US Environmental Protection Agency, November 1992.

Cost-effectiveness of the GEF Funding

34. The cost-effectiveness of an individual GEF project can be determined by calculating the incremental cost on an annualized per ton basis, using a 12 percent annuity rate. It would represent from a national point of view the appropriate compensation for the reduction of CO_2 emissions. The cost-effectiveness is about US$37/ton of CO_2 reduced for condensing boilers at Jana Street and US$67/ton of CO_2 reduced for cogeneration schemes at Warszawska Street. In Norway, the marginal cost of stabilizing the emission level of greenhouse gases by the year 2000 at their 1989 level through domestically implemented measures is estimated at about US$180 per ton of CO_2. In some Western European countries, the tax on CO_2 is in the range of US$25-60 per ton of CO_2.[4/]

Sensitivity Analysis

35. The cost-effectiveness of the GEF funding depends on both the conversion technology and financial parameters. A sensitivity analysis was carried out on energy prices, labor costs and environmental fees. Energy prices were increased to economic levels: US$10.0 per MWh for electricity; US$18-20 per Nm^3 for gas; and US$12.0 per GJ for heat. Labor costs were increased in real terms at 5 percent per year. Environmental fees were raised to levels that truly reflect the costs of the environmental damage resulting from emissions from low-level stacks. These fees were estimated at: US$325 per ton for SO_2; US$2,160 per ton of dust; and US$400 per ton of NOx. Table 19-3 of this annex presents the results of the analysis. A summary of the key results follows.

36. For the condensing boiler technology at Jana Street, the introduction of higher environmental fees alone could reduce the GEF grant from 34 percent to 19 percent of the GEF project cost. A 5 percent yearly increase in labor cost would alone provide the financial incentives to the boiler owner to convert to gas (although the incremental IRR is increased to 17 percent, still below the required 25 percent target). (A 10 percent yearly increase in labor cost would eliminate the need for GEF financing.) If the required IRR were reduced to 22 percent, the combined increases in gas prices, environmental fees and labor costs would make the conversion to high-efficiency technology financially attractive without concessional funding.

37. For the cogeneration technology, the increase in electricity prices would result in additional revenues from the sales of electricity. Together with the increase in the price of gas, the net effect is a reduction in the GEF grant from 60 percent to 30 percent of the GEF project cost, bringing the cost-effectiveness of the GEF grant from US$67 to US$40 per ton of CO_2 reduced. To make the cogeneration technology self-sustainable without GEF concessional funding, the required IRR should be reduced from 25 percent to 13 percent.

4/ Source: "A Comparison of Carbon Taxes in Selected OECD Countries," OECD Environment Monograph 78/1993.

PART E - COST-EFFECTIVENESS OF THE ENERGY EFFICIENCY FUND

38. A marginal cost analysis was carried using estimated economic levels for electricity and heat prices and a 50-year service life for a building. Detailed calculation of the benefits and cost-effectiveness of the EE Fund is presented in Table 19-4 of this annex. Depending on the energy efficiency and conservation measures considered, the reduction in CO_2 emissions would range from 212 to 645 tons per year, representing 28% to 40% reduction compared with baseline conditions. The incremental costs on an annualized per ton basis at a 12% annuity rate are in the range US$187-225 per ton of CO_2 reduced. The energy-related incremental investments have an average payback period of 9 years and an IRR of 11 percent.

POLAND - COAL-TO-GAS CONVERSION PROJECT

Marginal Costs Analysis
At Facility One - Jana Street

YEAR	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
REFERENCE CASE - REPLACEMENT OF EXISTING BOILERS AFTER 25 YEARS OF SERVICE WITH NEW COAL-FIRED BOILERS																		
Investment																		
- Annual	214.7											103.3	78.4					50.5
- Present Value @ 25%	230.1																	
Operating Expenses																		
Coal/Coke	44.2	27.9	28.6	29.4	30.1	30.8	31.6	32.4	33.2	34.1	34.9	35.8	36.7	37.6	38.5	39.5	40.5	41.5
O&M	48.8	24.4	25.0	25.6	26.3	26.9	27.6	28.3	29.0	29.7	30.5	31.2	32.0	32.8	33.6	34.5	35.3	36.2
Labor	11.7	19.8	20.3	20.8	21.3	21.8	22.4	22.9	23.5	24.1	24.7	25.3	26.0	26.6	27.3	28.0	28.7	29.4
Environmental Fees	0.8	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.7	0.7
Total - Operating Expenses	105.5	72.6	74.4	76.3	78.2	80.0	82.1	84.1	86.2	88.4	90.7	92.9	95.3	97.6	100.0	102.6	105.2	107.8
GEF PROJECT CASE - CONVERSION OF EXISTING COAL-FIRED BOILERS TO GAS-FIRED CONDENSING BOILERS																		
Investment																		
- Annual	385.4																	
- Present Value @ 25%	385.4																	
Operating Expenses																		
Gas	44.2	51.1	52.4	53.7	55.0	56.4	57.8	59.3	60.7	62.3	63.8	65.4	67.1	68.7	70.4	72.2	74.0	75.9
O&M	48.8	13.1	13.5	13.8	14.2	14.5	14.9	15.2	15.6	16.0	16.4	16.8	17.2	17.7	18.1	18.6	19.0	19.5
Labor	11.7	2.2	2.3	2.3	2.4	2.4	2.5	2.5	2.6	2.7	2.7	2.8	2.9	3.0	3.0	3.1	3.2	3.3
Environmental Fees	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total - Operating Expenses	105.5	66.4	68.2	69.8	71.6	73.3	75.2	77.0	78.9	81.0	82.9	85.0	87.2	89.4	91.5	93.9	96.2	98.7
INCREMENTAL ANALYSIS																		
Present Value of Incremental Investment	(155.3)																	
Operating Savings	0.0	6.2	6.2	6.5	6.6	6.7	6.9	7.1	7.3	7.4	7.8	7.9	8.1	8.2	8.5	8.7	9.0	9.1
Incremental Cash Flow	(155.3)	6.2	6.2	6.5	6.6	6.7	6.9	7.1	7.3	7.4	7.8	7.9	8.1	8.2	8.5	8.7	9.0	9.1
Internal Rate of Return	-2%																	

PROJECT BENEFITS

GEF CONTRIBUTION		MARGINAL COSTS OF NET CO2 REDUCTION		
Boiler Owner's Cost of Capital (or Required IRR)	25.0%	CO2 Emission Reduction	494	tons per year
Capital Subsidy Required to Achieve 25% IRR (GEF Grant)	129.0	Incremental Costs		
GEF Grant as Percent of GEF Project Cost	34%	on an annualized per ton basis, using 12% annuity rate	$37	per of ton of CO2 reduction

POLAND - COAL-TO-GAS CONVERSION PROJECT

Marginal Costs Analysis
At Facility Two - Warszawska Street

YEAR	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
REFERENCE CASE - REPLACEMENT OF EXISTING BOILERS AFTER 25 YEARS OF SERVICE WITH NEW COAL-FIRED BOILERS																		
Investment																		
- Annual	506.0			1,286.9					92.2	359.4								340.1
- Present Value @ 25%	1,242.7																	
Operating Expenses																		
Coal/Coke	217.5	159.8	163.8	167.9	172.1	176.4	180.8	185.3	189.9	194.7	199.5	204.5	209.6	214.9	220.3	225.8	231.4	237.2
O&M	166.5	138.8	142.3	145.8	149.5	153.2	157.0	161.0	165.0	169.1	173.3	177.7	182.1	186.7	191.3	196.1	201.0	206.1
Labor	29.3	49.5	50.7	52.0	53.3	54.6	56.0	57.4	58.8	60.3	61.8	63.3	64.9	66.5	68.2	69.9	71.6	73.4
Environmental Fees	5.3	3.5	3.6	3.7	3.8	3.8	3.9	4.0	4.1	4.2	4.4	4.5	4.6	4.7	4.8	4.9	5.0	5.2
Total - Operating Expenses	418.6	351.6	360.4	369.4	378.7	388.0	397.7	407.7	417.8	428.3	439.0	450.0	461.2	472.8	484.6	496.7	509.0	521.9
GEF PROJECT CASE - CONVERSION OF EXISTING BOILERS TO GAS-FIRED HEAT SUPPLY SYSTEM USING BASELOAD COGENERATION UNIT AND PEAKING HEAT-ONLY-BOILERS																		
Investment																		
- Annual	1,215.5	3,737.7																
- Present Value @ 25%	4,212.9																	
Incremental Revenues																		
Sales of Cogenerated Electricity			261.2	267.7	274.4	281.3	288.3	295.5	302.9	310.5	318.2	326.2	334.4	342.7	351.3	360.1	369.1	378.3
Operating Expenses																		
Gas	217.5	243.7	439.7	450.7	461.9	473.5	485.3	497.4	509.9	522.6	535.7	549.1	562.8	576.9	591.3	606.1	621.2	636.8
O&M	166.5	208.2	127.7	130.9	134.1	137.5	140.9	144.4	148.1	151.8	155.6	159.4	163.4	167.5	171.7	176.0	180.4	184.9
Labor	29.3	49.5	11.3	11.5	11.8	12.1	12.4	12.7	13.1	13.4	13.7	14.1	14.4	14.8	15.2	15.5	15.9	16.3
Environmental Fees	5.3	5.4	0.6	0.6	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8	0.9	0.9	0.9
Total - Operating Expenses	418.6	506.8	579.3	593.7	608.5	623.8	639.3	655.2	671.8	688.5	705.8	723.4	741.4	760.0	779.0	798.5	818.4	838.9
INCREMENTAL ANALYSIS																		
Present Value of Incremental Investment	(2,963.0)																	
Operating Savings	0.0	(155.2)	42.3	43.4	44.6	45.5	46.7	48.0	48.9	50.3	51.4	52.8	54.2	55.5	56.9	58.3	59.7	61.3
Incremental Cash Flow	(2,963.0)	(155.2)	42.3	43.4	44.6	45.5	46.7	48.0	48.9	50.3	51.4	52.8	54.2	55.5	56.9	58.3	59.7	61.3
Internal Rate of Return	-11%																	

PROJECT BENEFITS

GEF CONTRIBUTION	
Boiler Owner's Cost of Capital (or Required IRR)	24.7%
Capital Subsidy Required to Achieve 25% IRR (GEF Grant)	2,941.2
GEF Grant as Percent of GEF Project Cost	60%

MARGINAL COSTS OF NET CO2 REDUCTION		
CO2 Emission Reduction	6168	tons per year
Incremental Costs		
on an annualized per ton basis, using 12% annuity rate	$67	per of ton of CO2 reduction

POLAND - COAL-TO-GAS CONVERSION PROJECT

Marginal Cost Analysis
Sensitivity Analysis

	BASE CASE	Increase in Environmental Fees a/		Increase in Labor Costs			Increase in Energy Prices b/ c/		All Increases Combined	
				5% per year		Breakeven				
		Max IRR	Min IRR	Max IRR	Min IRR	Increase	Max IRR	Min IRR	Max IRR	Min IRR
HIGH-EFFICIENCY CONDENSING BOILER TECHNOLOGY										
1. Real Increase in Labor Costs				5%	5%	10%				
2. Incremental IRR	-2%	12%	15%	17%	18%	25%	-20%	-18%	21%	22%
3. Required IRR										
2.1 Boiler Owner	25%	25%		25%		25%	25%		25%	
2.2 Minimum Target	12%		15%		18%			12%		22%
4. GEF Grant as Percent of GEF Project Cost	34%	19%	0%	15%	0%	0%	40%	28%	7%	0%
5. Annualized Incremental Costs (in US$ per ton of CO2 reduction)	$37	$21	$0	$16	$0	$0	$44	$31	$7	$0

Notes: a/ Environmental fees increased to: SO2: US$325/ton; Dust: US$2160/ton; NOx: US$400/ton.
b/ For Facility at Jana Street, gas price is increased to UScent20/Nm3.

	BASE CASE	Env. Max IRR	Env. Min IRR	Labor 5% Max IRR	Labor 5% Min IRR	Breakeven Increase	Energy Max IRR	Energy Min IRR	All Max IRR	All Min IRR
COGENERATION TECHNOLOGY										
1. Real Increase in Labor Costs				5%	5%	20%			5%	5%
2. Incremental IRR	-11%	-5%	-4%	-3%	-2%		7%	9%	11%	13%
3. Required IRR										
2.1 Boiler Owner	25%	25%		25%			25%		25%	
2.2 Minimum Target	12%		12%		12%	12%		12%		13%
4. GEF Grant as Percent of GEF Project Cost	60%	57%	42%	57%	42%	0%	42%	12%	36%	0%
5. Annualized Incremental Costs (in US$ per ton of CO2 reduction)	$67	$64	$47	$64	$47	$0	$47	$13	$40	$0

Notes: c/ For facility at Warszawska Street, gas and electricity prices are increased to UScent18/Nm3 and US$10/MWh, respectively.

POLAND - COAL-TO-GAS CONVERSION PROJECT
Cost-Effectiveness of Energy Efficiency Fund for New Residential Buildings

Data on Residential Units

Average Unit Area	67.9	m2
Occupancy Factor	0.036	people per m2
Service Life for Buildings	50	years

Assumptions

Economic Price for Heat		$12.5	per GJ
Economic Price for Electricity		$100.0	per MWh
Heat Supply Sources	Production Mix		Efficiency
- Individual gas furnaces	50.0%		85.0%
- Coal-fired boilers	50.0%		80.0%
Efficiency of Electricity Production in Coal-Fired Plants			34.0%

Energy Efficiency & Conservation Measures

	Incremental Energy Savings	Costs	
Increased Insulation of Wall, Ceiling & Window	20% (heat saving)	$7.44	per m2
Improved Automation & Control of Heat Installation	10% (heat saving)	$2.95	per m2
Heat Recuperator	20% (heat saving)		
- per single family detached two-story house (150 m2)		$913	per house
- per apartment building (converted into m2 basis)		$6.09	per m2
Efficient Electric Appliances & Improved Comsumption Behavior	25% (electricity saving)	$450	per unit

Costs of Efficiency Measures	*Total Energy Savings*			*Number of Units*	*Number of*
	Heat	*Electricity*	*Cost per Unit*	*within Fund Budget*	*People*
- without Heat Recuperator	28%	25%	$1,155	801	1955
- with Heat Recuperator	42%	15%	$1,388	666	1625

Fund Allocated for Energy Efficiency and Conservation Measures (including US$75,000 Administration, Energy Audit & Monitoring) **$1,000,000**

	ENERGY CONSUMPTION					
	Before	After	Savings	% Reduction	Without Heat Recuperator After	Without Heat Recuperator % Reduction
REDUCTION IN ENERGY CONSUMPTION (including heat recuperator)						
Heat Consumption Factor (Excluding Heat Recuperator)						
- in kWh per m2	101.81	58.55	43.26	42%	73.19	28%
- in MJ per m2	366.52	210.78	155.73		263.48	
Electricity Consumption Factor (in kWh/m2/person)	12.76	10.84	1.91	15%	9.57	25%
HEAT SAVINGS (including savings from heat recuperator)						
Heat Consumption: - in GJ	16,574	9,532	7,042		14,330	
Heat Required (in GJ) from: - Individual gas furnaces	8,287	4,766	3,521		7,165	
- Coal-fired boilers	8,287	4,766	3,521		7,165	
Fuel Used (in GJ) - Gas	9,749	5,607	4,142		8,429	
- Coal	10,359	5,958	4,401		8,956	
CO2 emissions from Heat Savings (in tons)						
- Individual gas furnaces	517	297	220	43%	447	28%
- Coal-fired boilers	953	548	405	42%	824	28%
Sub-total	1,470	845	625	43%	1,271	28%
ELECTRICITY SAVINGS (reduced by electricity consumed by heat recuperator)						
Electricity Consumption (in MWh)	1,408	1,197	211	15%	1,270	25%
Coal Consumption at Power Plants (in MWh)	4,141	3,521	620		3,735	
CO2 Emission Reduction at Power Plants (in tons)	130	110	20	15%	117	25%
COST-EFFECTIVENESS CALCULATION						
Total CO2 emission reduction (in tons)	1,600	955	645	40%	1,388	28%
Annual Cost Savings (in US$) - heat	207,175	119,150	88,025	42%	179,125	28%
- electricity	140,800	119,700	21,100	15%	127,000	25%
Total	347,975	238,850	109,125	31%	306,125	27%

	with Heat Recuperator	without Heat Recuperator
Incremental Cost (on annualized per ton basis, @ 12% annuity rate) (US$/ton of CO2 reduced) /a	$187	$225
Payback Period (years)	9.2	8.9
Rate of Return	10%	11%

Note: /a Assume equal annual operating costs for units, with or without efficiency measures.

POLAND - COAL-TO-GAS CONVERSION PROJECT

Technical Assistance for Project Management and Consultancy Services

1. The technical assistance for project management and consultancy services is a key component of the GEF project, intended to permit smooth implementation. This assistance would be provided for a number of project activities and participants. However, it is sufficiently flexible to permit reorientation toward other high priority areas that may emerge during project implementation. The following provides a brief overview of the technical assistance services to key project participants such as the Bank Ochrony Srodowiska SA (BOS), the Scientific and Technical Advisory Panel (STAP), the local Technical Advisory Groups (TAGs) and the prospective beneficiaries (boiler owners and new residential building owners).

2. For Central BOS Office. Technical assistance would be required in the following areas:

(a) Education on standard World Bank procurement and disbursement procedures. Assistance would be provided by Bank staff and consultants and through specialized training courses;

(b) Improving local capabilities in project administration and financing, implementation management, performance monitoring and reporting procedures, plus international financial procedures. Assistance would be provided by qualified consultants;

(c) Acquisition of capabilities to use and interpret the cost-benefit spreadsheet model for coal-to-gas conversion projects. Assistance would be provided by Bank staff; and

(d) Implementation of the marketing plan for the project. Assistance would be provided by a qualified contractor.

3. For Regional BOS Offices. Technical assistance would be in the same general areas as for the central BOS office, but with the following differences:

(a) Emphasis on learning procedures for evaluating the technical and financial viability of the projects within the GEF criteria. This assistance to regional BOS staff includes: (i) informing project applicants about GEF criteria and application requirements; (ii) acquiring the capability to carry out technical and financial appraisals of project applicants; (iii) acquiring the capability to adapt the cost/benefit spreadsheet model for coal-to-gas conversion projects to specific sites and to interpret the results; (iv) acquiring the capability to supervise progress with project implementation and prepare progress reports; and (v) acquiring the capability to monitor the technical and environmental performance of GEF-supported projects and prepare project completion reports; and

(b) Implementation of the marketing plan for the project at the local level.

Assistance would be provided initially by qualified consultants and then by local experts from the local Technical Advisory Groups (TAGs).

4. **For the national Scientific Technical Advisory Panel (STAP).** Technical assistance would be provided to this group in the following areas:

(a) Understanding the objectives of the GEF Coal-to-Gas Conversion Project, the economic criteria, and the range and applicability of technical options on both the supply and demand sides of possible projects. Assistance would be provided by Bank staff and qualified consultants as needed;

(b) Acquiring the capability to use and interpret the cost/benefit spreadsheet model for coal-to-gas conversion projects. Assistance would be provided by Bank staff as needed; and

(c) Assistance on specific technical subjects and issues related to specific projects being reviewed, as required or requested.

Assistance would be provided by Bank staff and qualified consultants through such means as visits, telephone calls and faxes, as appropriate.

5. **For local Technical Advisory Groups (TAGs).** Technical assistance would be provided to these groups in the same general areas as for the national STAP and regional BOS offices, as listed above. The regional BOS offices would coordinate the assistance. Initially qualified consultants and later STAP, central BOS office, and regional BOS offices and the local TAGs, which would already have benefited from such assistance, would provide the services. These later groups would serve as trainers of trainees.

6. **For Boiler Owners.** Technical assistance to boiler owners would available in the following areas: (a) for projects at the identification phase, assistance to project applicants in the preparation of project proposals consistent with GEF funding requirements; and (b) for applicants whose project proposals have been approved by STAP, assistance in implementing the project, from conceptual design to full operations, including monitoring requirements. Assistance would be provided by regional BOS offices, local experts or TAG members and qualified engineering consultants acting as boiler owner representatives.

7. **For Owners of New Residential Buildings.** Technical assistance to owners of new residential buildings would be in the area of auditing for energy efficiency in new residential buildings. Assistance would be provided by qualified local energy auditors.

POLAND - COAL-TO-GAS CONVERSION PROJECT

Scientific and Technical Advisory Panel (STAP)
(Terms of Reference)

Roles of STAP

1. STAP's major role would be to ensure that all GEF projects are designed and accomplished in a technically sound manner. In this role, STAP would function as the technical advisor and partner to the Ministry of Environmental Protection, Natural Resources and Forestry (MoE) and the Bank Ochrony Srodowiska SA (BOS) in accomplishing project activities. STAP would meet routinely to provide an independent technical review of all candidate projects to ensure the project designs comply with the GEF scientific and technical requirements and also to assess the cost-effectiveness of these candidates and their priorities for GEF funding. STAP would determine if the design of each identified project meets the stated GEF requirements and would inform BOS (and MoE) as to its decisions. STAP's decision on project approval would be final.

Qualifications of STAP Members

2. STAP would consist of five scientists, two of whom would be international (a gas cogeneration specialist and an energy economist) and three from Poland (including an energy audit/end-user energy efficiency specialist, a district heating specialist, and an instrumentation and monitoring specialist). These advisors should be independent without affiliation with the institutions involved (or which could potentially be involved) in the decision-making of follow-up projects, yet to be identified. MoE will nominate the members of the panel and the Bank would review their qualifications and experience and approve their appointment.

Scope of Work -- List of Major Responsibilities and Deliverables

3. <u>STAP Chairman and Secretary</u>.

(a) MoE would designate the STAP chairman and secretary;

(b) The STAP chairman would be responsible for coordinating STAP activities and providing liaison with MoE, BOS and local experts and Technical Advisory Groups (TAGs). The STAP chairman may delegate some or all of the liaison functions to the STAP secretary as appropriate; and

(c) The STAP secretary would be responsible for documenting STAP actions and decisions.

4. <u>STAP Meetings</u>.

(a) The panel would meet two to three times a year, or as necessary, to review applications for GEF funding;

(b) STAP may also meet at other times as required to accomplish its responsibilities; and

(c) STAP expenses related to travel, subsistence and honoraria for both Polish and external specialists would be supported from GEF project resources to ensure an independent technical perspective.

5. **Independent Technical Review of all Candidate Projects Applying for GEF Funding**.

(a) During the project preparation phase, STAP would assist BOS in: (i) reviewing the second tranche of pilot projects, selected from an already identified list of individual projects; and (ii) refining, inter alia, the detailed rules and procedures for the early steps in the project development cycle; and

(b) At this stage STAP would provide an independent technical review of all applicants for GEF funding and ensure that their project designs comply with the GEF scientific and technical requirements. STAP would also assess the cost-effectiveness of these candidates, their priorities for GEF funding. STAP would review the amount of GEF grant contribution to the project financing. A quorum for STAP meetings would be three or more members, including at least one international STAP member. All STAP decisions to approve projects to receive GEF grant assistance under this project shall be by unanimous vote. STAP would inform BOS (and MoE) as to its decisions. STAP's decision on project approval would be final.

6. **Defining the Technical Requirements and Supervising Consultants**.

(a) For projects at the appraisal stage, the STAP would: (a) develop terms of reference (TORs) for the services of the TAG members or technical advisors to assist BOS in the appraisal of individual coal-to-gas candidate projects for GEF funding; (b) review the selection process and approve GEF funds for TAG services; (c) review TAG members' products; and (d) approve GEF funding for project implementation.

(b) For projects at the implementation stage, STAP would: (a) develop TORs for the services of the project engineers acting as the boiler owners' representatives; (b) review the selection process and approve GEF funds for the boiler owners' representatives; and (c) designate a STAP member to oversee project implementation from the conceptual phase to full operation, including monitoring of project performance. Depending on the size of a project, STAP may delegate the responsibility for oversight of project implementation to a member of the local TAG members. Depending on the geographical location of individual conversion projects and their size, STAP may develop TORs for the services of an owners' representative to cover a group of individual projects.

(c) STAP may also assist BOS in defining the technical requirements for other project activities.

7. Technical Assistance and Information Dissemination. Besides its technical review, STAP would:

(a) provide technical assistance to local experts and TAGs as requested;

(b) set up a national network for the dissemination and exchange of information among all local experts and technical advisors, building upon existing information sources and channels, including libraries. This would, inter alia, stimulate international exchanges of information and technical cooperation (such as twinning arrangements between Polish and foreign technical institutions), where possible; and

(c) implement other information programs (such as newsletters, seminars, and presentations at meetings of technical societies) to ensure widespread dissemination of STAP activities to the relevant Polish technical communities, so as to facilitate project replicability throughout Poland. Members of the technical community might include representatives from universities, professional architecture and engineering societies, codes and standards organizations, related institutions, foundations and affected industries (for example, boiler suppliers, monitoring equipment suppliers and insulation manufacturers, owners of buildings and heating systems, heating system operators, architect engineering and construction firms).

Delegation of STAP Activities

8. As necessary, STAP may delegate specific activities to local individual experts, firms or members of the local TAGs. Sub-contracting arrangements would be evaluated case-by-case and funded from STAP's allocated budget. Each sub-contractor would carry out the activities under the supervision of STAP.

Budget for the STAP

9. An estimated budget of US$190,000 for STAP activities has been allocated under the proposed project. A detailed breakdown of this budget is presented in Table 21-1 of this annex.

POLAND - COAL-TO-GAS CONVERSION PROJECT

Budget Estimate
for the Scientific and Technical Advisory Panel

A. STAP members

Number of experts
- Foreign = 2
- Polish = 3

B. Cost Parameters

	Services (per day)	Per diem Allowances	Travel International	Travel Within Poland
- Foreign	$600	$150	$2,420	
- Polish	$200	$50		$100

C. Costs of Project Review Meetings

Number of year = 3
Number of meetings per year = 3
Number of days
- per meeting = 3
- per report writing & documentation follow-up = 1

Number of days for roundtrip travel
- International travel = 2
- within Poland = 1

	Services		Travel		Subsistence		Total
	Time	Costs	Number	Costs	Time	Costs	Costs
- Foreign	108	$64,800	18	$43,560	72	$10,800	$119,160
- Polish	135	$27,000	27	$2,700	108	$5,400	$35,100
Total	243	$91,800		$46,260	180	$16,200	$154,260

D. Project Supervision & Ad-hoc Advisory Services

Number of days per year
- Foreign = 2
- Polish = 8

Allocation for services		*Time*	*Costs*
- Foreign	=	12	$7,200
- Polish	=	72	$14,400
Total	=	84	$21,600

E. Overall Project Performance Monitoring and Evaluation

Number of days
- per meeting = 2
- per report writing & documentation follow-up = 1

Number of days
- International travel = 2
- within Poland = 1

	Services		Travel		Subsistence		Total
	Time	Costs	Number	Costs	Time	Costs	Costs
- Foreign	10	$6,000	2	$4,840	3	$450	$11,290
- Polish	12	$2,400	3	$300	3	$150	$2,850
Total	22	$8,400		$5,140	6	$600	$14,140

F. Budget estimates for STAP

Budget Allocation	*Costs*
- Foreign experts	$137,650
- Polish experts	$52,350
Total	***$190,000***

POLAND - COAL-TO-GAS CONVERSION PROJECT

Boiler Owners' Representative (Terms of Reference) [1/]

Role of Boiler Owner Representatives

1. Each owner of a project heating system would have a boiler owner's representative to assist in finalizing project definition, preparing project specifications and a request-for-proposals package, evaluating the proposals received, recommending the contract award, assisting in contract negotiations, carrying out supervision/periodic inspection of the contractor's work, and assuring the owners of the validity of the acceptance testing upon completion of each individual project. The owners' representatives, acting as project managers, would be responsible for bringing each individual project from the conceptual phase to full operations.

2. The owners' representative would also provide training to the local/regional offices of Bank Ochrony Srodowiska SA (BOS) in the areas of:

(a) Energy efficiency and effectiveness in reducing pollutant emissions; and

(b) Preparation/updating of the project operations handbook based on actual experience with the initial monitoring and the completion of the two pilot projects in Krakow. The project handbook would provide guidelines and a reference source to assist BOS, future project proposers and their consultants, and contractors in identifying projects that would be effective in implementing the objectives of the GEF project.

Qualifications of the Owners' Representatives

3. The owners' representatives should have extensive first-hand experience in engineering and specification of the assembly of the components of small-scale installations such as: (a) highly efficient gas-fired heating boilers, condensing and non-condensing technology type; and (b) cogeneration assemblies of natural gas engines and gas turbine-powered generators of 1.0-1.5 Megawatt-electric and efficient heat recovery boilers and auxiliary equipment such as a gas compressor to boost the incoming natural gas pressure to a level sufficient for firing a gas turbine.

4. Because of its importance within the GEF pilot phase, it is expected that

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1/ These terms of reference were developed for the boiler owners' representative of the two pilot projects in Krakow. They could be adapted for follow-up conversion projects as required.

GEF participant countries would review the Poland - GEF Coal-to-Gas Conversion Project intensively for potential replicability. Therefore, above all the owners' representatives would assure the owners of reliable, efficient and trouble-free installation and state-of-the-art economic performance, project implementation and monitoring, all of which could serve as a model for similar installations throughout the country and elsewhere.

5. Given the small size of these individual projects, some of the activities listed in the scope of work, such as providing conceptual designs for new installations may, as a practical matter, essentially copy the design of a similar project. The same may hold true for the specifications, which may consist of a package plant that may be largely preassembled and tested and require minimum on-site assembly. Therefore, the owner's representatives should have extensive experience in successfully executing similar end-user energy efficiency and conservation projects, small heat plants and small combined heat and power plants, including project design, engineering, construction supervision, operation, maintenance and monitoring. In addition, to the extent that there are valid designs, specifications and other documents already available from similar projects, and in order to conserve time and resources, the owner's representatives should utilize, to the maximum extent possible, existing system designs that have been shown to operate successfully.

General Guidelines for the Owners' Representatives

6. Transfer of Know-How. Throughout project preparation and implementation, the process should be thoroughly documented to ensure its use for future replicability. The owners' representatives are required to work closely with the owners and ensure effective participation of local counterparts for a continuous transfer of know-how. In addition to the obvious benefits that result from having a local firm that understands local customs and the best sources of services and assistance, it is the intent of this requirement that local firms be able to gain experience and perspective on projects and technologies such as those included in the two GEF pilot projects in Krakow and to develop their capabilities independently to carry out future projects effectively.

7. Local and National Regulatory Considerations. The owners' representatives are required to investigate and document the logistics, procedures and institutional requirements to be followed in the construction, safe operation and maintenance of gas-fired boilers and small cogeneration plants. They are also required to obtain and document all regulatory information on small district heating plants that may have an impact on the contemplated projects, especially gas storage, ambient air quality and air emissions, waste water discharges, solid waste disposal, noise and occupational and health hazards, if any.

8. Incremental Economic and Financial Analysis - Sensitivity Analysis. An approach to evaluate economic and global environmental objectives and determine the cost-effectiveness of technology options for emission reduction needs to be defined and followed, particularly with options that are not least-cost but are least polluting. The owners' representatives should use: (a) a new coal-fired

heat-only boiler option as the base case and the national economic perspective as the basis for evaluating options; and (b) consider a set of technology options that respond to the GEF project objectives but that are marginally economic from the country's point of view and that would likely not be implemented without GEF concessional financing. Given the volatility of the prices for network fuels and their move toward economic levels, analysis of price sensitivity for the identification and justification of options should be carried out. This analysis would provide the basis for justifying the use of GEF funds and determining the size of the GEF grant needed to justify the preferred option or set of options on economic as well as environmental grounds.

9. Preparation of Specific Recommendations. In preparing specific recommendations for the design for each individual project, the owners' representatives would:

(a) in the case of heat-only-boiler projects, evaluate the economic and technical merits of high-efficiency gas-fired non-condensing heat-only-boilers versus higher efficiency gas-fired condensing boilers; and

(b) in the case of cogeneration projects: (i) evaluate the technical and economic merits of utilizing internal combustion engines versus gas turbine-driven generators; (ii) consider whether one or more than one engine-driven or gas turbine generators are needed; and (iii) evaluate the merits of providing the capability for supplemental firing of heat recovery boilers, including the use of natural gas-fueled duct burners for gas turbine exhaust as compared with separate peaking boilers for meeting heating needs on the coldest days. The owners' representatives would also evaluate the merits of including absorption chillers in the cogeneration plant either for serving an external cooling load or for cooling the gas turbine inlet air to achieve higher capacity and improved efficiency. The objective is to ensure a high load factor for the contemplated cogeneration scheme. The owners' representatives would evaluate the possibility of introducing heat accumulators to meet peak demand for heat as well as to provide an autonomous heat supply when additional electric capacity from the cogeneration unit is needed.

10. For all individual projects, to assure reliability and uninterrupted operation during the heating season in the event of a loss of gas supply, the owners' representatives would consider a dual-firing capability and incorporate appropriate specifications for the use of distillate fuel.

11. In preparing specific recommendations for the capacity and configuration of cogeneration projects, typical/possible configurations could include, but are not necessarily limited to, the following:

(a) Gas turbine or gas-fueled internal combustion engine exhausting into a low pressure heat recovery boiler;

(b) Gas turbine exhausting into a higher pressure heat recovery boiler, with the possibility of generating steam for injection into the gas turbine for added electric generating capacity;

(c) Combined-cycle cogeneration scheme, consisting of a two-cycle system -- gas turbine exhausting into a higher pressure heat recovery boiler, with the possibility of generating high pressure steam to supply a steam turbine for added electric generating capacity;

(d) Gas turbine or natural gas-fueled internal combustion engine exhausting into a higher pressure heat recovery boiler, with the possibility of generating steam for utilization in an absorption chiller for either commercial refrigeration or for cooling the gas turbine inlet air with or without ice storage to permit, inter alia, more efficient gas turbine operation during the warmer months; or

(e) High temperature recuperators for regenerative heating of the compressed gas turbine combustor inlet air;

In all the above cases, the owners' representatives should evaluate the merits of (a) a single engine or gas turbine-driven generators versus multiple units and (b) high-efficiency heat recovery boilers versus very high-efficiency condensing heat recovery boilers.

12. At all project sites, the owners' representatives would be required to introduce innovative features and technologies into the conceptual design of each project.

13. In evaluating the merits of possible configurations for each site, the owners' representatives would be required to: (a) analyze the options; (b) develop an economic and financial analysis for each option; and (c) taking practicality into account, recommend the option with the highest cost/benefit ratio for reducing emissions of carbon dioxide (CO_2).

Scope of Work - List of Major Tasks and Deliverables

14. The owners' representatives would include the results of these analyses and studies in a report to the owner for each site, offering specific recommendations for the heating plant and cogeneration plant, for the renovation of the heat distribution and transfer systems, and for improving the efficiency of energy use within the buildings and facilities served. This report would specifically address each of the requirements listed below, which would also be the basis for the GEF project operations handbook:

15. <u>Task One: Project Definition and Conceptual Design</u>

(a) Determination of the heat demand for each individual project and, for each cogeneration project, determination of the optimum and practicable electricity generation capacity. The owners' representatives would: (i) review the present and anticipated future demand for heat supply, both hot water and steam, for each project site and analyze the heat load duration curve; (ii) review the present/future electricity demand for the facilities served by the cogeneration projects; and (iii) identify the optimum heat supply mix throughout the year, including the possibility of using absorption chilling;

(b) Preparation of a conceptual design and detailed cost estimates for the recommended heating boiler and cogeneration plants, for the renovation of the heat distribution and transfer systems, for improved efficiency in energy use in the buildings and facilities served, and for the connection of the new facilities to the gas, electricity and heat networks. This sub-task should include at least the following:

(1) A project description, including a discussion of the specific technologies recommended for the new heating and cogeneration plants, for the rehabilitation of the heat distribution and transfer systems, and for the improvement in the efficiency of energy use in the buildings included in the individual projects, along with a discussion of the alternatives considered and a justification of the recommended option. This description should cover the instrumentation and controls package, the project efficiency and emissions monitoring package, and auxiliary and supporting facility requirements, including provisions for receiving and storing back-up distillate fuel. It would also cover all necessary provisions for the safe removal and disposal of existing heating facilities, protection of the environment and employee/public health and safety;

(2) Discussion of specific site and technology constraints and potential problem areas. This discussion would include, but not necessarily be limited to: (i) the intake air and fuel quality required for reliable long term operation of the gas turbines; (ii) gas supply pressures and the probable need for the inclusion of a gas compressor station if gas turbines are employed; (iii) the specific restrictions imposed by siting in a historical area, such as limited vehicle access; (iv) space limitations; (v) renovation of existing buildings; and (vi) probable requirements for retaining the external architectural features of existing structures and likely prohibition on new permanent buildings, etc.;

(3) Energy and material balances for the new boiler house and cogeneration units, including conventional pollutant and waste materials balances and balances for sulfur dioxide (SO_2), nitrogen oxides (NOx), particulates and CO_2, for both the selected technologies and the system being replaced. Energy and water/steam balances should also be shown for the rehabilitated heat distribution systems and for the buildings and facilities (cafeteria, laundry) included in each project;

(4) Flow diagrams incorporating all major equipment items for the principal processes in the heating and cogeneration plants, heat distribution and transfer systems, and buildings and facilities served;

(5) Site plan showing the major building or buildings, location of service connections such as water, natural gas, electrical distribution system, sewers, and location of back-up fuel (oil) tanks and vehicle access to and within the site;

(6) Facility/building section and plan views for the heating and cogeneration plants showing the location of the principal equipment, including heat accumulators if used, the control center, offices, storage areas for materials, supplies and spare parts, and maintenance facilities;

(7) The architect's perspective of the layout of the equipment for the heating and cogeneration plants within their respective buildings. One approach would be to show a perspective of the entire building with an exterior wall cutaway so as to show the equipment inside;

(8) Project cost estimates, including a breakdown of the costs in both local and foreign currencies;

(9) An estimate of the operating and maintenance costs;

(10) Guidance on the operation and maintenance of the new facility;

(11) An analysis of the manpower resources required, project implementation organization, job descriptions and a staffing plan, including an assessment of the training needs;

(12) Specific recommendations for the safe removal and disposal of all equipment in existing boiler houses scheduled to be retired in connection with the individual projects;

(13) A detailed logic diagram of activities and schedule, identifying milestones for each project. This diagram would require the detailed implementation planning and work scheduling, taking into account the operational constraint of supplying heat to end-users during the heating season. Various options for work schedules should be evaluated as to their impacts on both the interruptibility of heat supply and project costs;

(14) Discussion of the environmental and aesthetic impacts and considerations, including estimates of the quantities of pollutants and waste materials to be emitted or discharged;

(15) (i) Evaluation of alternative variations within the agreed-upon general concept for all individual projects; (ii) preparation of a site-specific conceptual design and cost estimate for each individual project (for example, in the case of the cogeneration project, would natural gas internal combustion engines be more suitable than gas turbines for the specific project; and in the case of all projects, can the cost of very high efficiency condensing heating boilers and heat recovery boilers and peaking boilers, if any, be justified as compared with the lower cost but still highly efficient non-condensing boilers);

(16) Design of an economic and easy-to-implement system for monitoring the in-service performance of GEF-funded projects over a period of years after implementation. Such a system would include a standardized system for measuring reductions in emissions of SO_2, NOx, CO_2 and particulates in a way that permits easy calculation and reporting by the project implementation office on an automated basis. The in-plant measurement system should be designed to be easily replicable at future GEF sites, regardless of the specific technologies employed, and should be compatible with an automated data analysis and reporting system. (This paragraph refers to a system. The elements of the standardized monitoring system to be located at the owners' facilities are to be designed and installed by the construction contractor so as to meet the monitoring and reporting system compatibility requirements specified by the owners' representatives.) This system would be used, inter alia, as a basis for producing verifiable project results and ensuring compliance with GEF project objectives; and

(17) Preparation of an economic and financial analysis to determine the amount of GEF incremental funding required. This analysis should include a financing plan, cash flow and disbursement profile; and

(c) Assistance to the owners in drafting and negotiating simple long-term agreements for: (i) sales of heat; (ii) sales of electricity; and (iii) supply of gas.

16. **Task Two: Procurement Strategy and Assistance in Bidding Process and Contract Award**. Upon approval of the specific project recommendations, the owners' representatives should:

(a) For each individual project, define the optimum procurement strategy, given the split between local and foreign cost, the alternatives being (i) a single engineering, procurement and construction (EPC) package or (ii) several subproject packages. In the latter case, the interface requirements need to be defined. One single bidding document for a EPC contract is highly recommended.

(b) Assist the project owners in preparing bid packages and bidding documents (technical and commercial specifications) for the new heating boiler and cogeneration plants, the rehabilitation work on the heat distribution systems, the energy efficiency improvement work on the buildings and facilities served, and the connection to gas and electricity networks.

The goods would be procured following the World Bank's competitive bidding procedures. The World Bank Procurement Guidelines and the now mandatory Standard Bidding Documents for Goods, Works and Services must be followed for all project procurement packages. These guidelines and documents would be made available to the owners' representatives.

The owners' representatives would include in the bid package a statement of the scope of work for providing and installing the facilities specified on a turn-key basis and for training the owners' management and staff in the proper operation and maintenance of all equipment and facilities supplied.

The EPC contractors shall assume all responsibility for delivering to the owners a project meeting all the specifications according to the agreed-upon schedule and cost, and in compliance with all local and national codes and regulations;

(c) Formulate in the bidding document post-qualification criteria to be met by prospective bidders to ensure the participation of internationally qualified contractors with substantial experience in supplying turn-key projects similar to and utilizing the technologies to be employed with all individual projects;

(d) Develop bid evaluation criteria to be included in the bidding documents and to be followed to ensure transparent evaluation of the bids;

(e) Upon receiving clearance from the World Bank on the bidding documents, assist the owners in issuing invitations to bid;

(f) Assist the owners in evaluating proposals received and recommend to the owners the proposal that most economically meets all individual project specifications and schedules and is determined to be responsive to the commercial and technical specifications of the bidding documents;

(g) Once the Bank approves the owner's recommendation of the lowest evaluated responsive bidder, assist the owner in negotiating a binding contract with the recommended bidder for delivering the turn-key projects;

17. **Task Three: Supervision of Construction Contractor's Work, including Acceptance Testing and Commissioning**.

(a) Review the contractor's designs and specifications;

(b) Carry out periodic supervision/inspection of the construction contractor's work in progress and monitor the construction contractor's compliance with specifications and schedules, including the fabrication of components at the manufacturers' facilities and final acceptance testing and commissioning of completed projects;

18. **Task Four: Preparation of GEF Project Operations Handbook**. Prepare and update the project handbook designed to assist the project implementation offices and future GEF proposers in developing, obtaining approval and implementing acceptable projects with a minimum of problems and expenses.

POLAND - COAL-TO-GAS CONVERSION PROJECT

Operations Handbook Consultant and Applications Processing Consultant (Terms of Reference)

1. Terms of Reference (TORs) for two consultants are defined here to assist the Bank Ochrony Srodowiska SA (BOS) with project implementation. One consultant would assist BOS in developing an Operations Handbook, including the development of application forms. The second consultant would assist BOS in processing the applications for GEF funding during the first round of projects in the nationwide program and in evaluating the first-round projects.

Operations Handbook Consultant
Scope of Work and List of Major Tasks and Deliverables

2. Task One: Assist BOS to Prepare Draft Operations Handbook. The first task would be to develop an Operations Handbook for the GEF Coal-to-Gas Conversion Project. This Operations Handbook would contain examples of all the forms and procedures needed to accomplish the project development cycle. For example, it should include such items as standardized application forms, detailed eligibility criteria, evaluation forms and procedures, form letters and draft TORs. Draft versions of some of these materials have already been developed, for example, as shown in Annexes 4, 8-11 and 21-24. These drafts would be developed in cooperation with the Scientific and Technical Advisory Panel (STAP) and central BOS office. These draft materials would be refined during the tasks below.

3. Task Two: Assist in a Training and Review Workshop. This workshop would be held to discuss and test the materials in the draft Operations Handbook. A key objective would be to refine the contents of the GEF Operations Handbook as a result of discussions at the workshop. Members of STAP, local experts, members of Technical Advisory Groups and BOS should participate. The workshop should focus in particular on reviewing and refining the GEF project evaluation criteria for clarity and appropriate detail to minimize problems during the first round of candidate project applications. Technical assistance requirements, mechanisms and procedures would also be discussed.

4. Task Three: Assist BOS to Refine the Operations Handbook. The Operations Handbook consultant should assist BOS to incorporate the refinements identified from the first round of applications and the evaluation workshop. The revised version should be suitable for distribution to and use by technical experts and regional BOS offices in designated regions and locales.

Applications Processing Consultant
Scope of Work and List of Major Tasks and Deliverables

5. Some 20 potential projects in several regions had been identified by the end of the appraisal mission. Additional projects would be identified from these and other regions and the set of applications would be evaluated together. The proposed schedule for initiating this first round of projects in the full, nationwide GEF program is shown in Table 18-3 of Annex 18. The Applications Processing consultant would assist BOS in processing this first-round projects in accordance with the following tasks.

6. **Task One: Assist BOS to Evaluate Applications**. During the first round of projects in a full nationwide program, the Applications Processing consultant would assist BOS in accomplishing steps 1-11 of the project flow diagram shown in Figure 8-1 of Annex 8. This assistance would include both technical and procedural inputs to the central BOS office and local BOS offices, as appropriate. For each applicant for GEF funding, BOS would receive assistance in accomplishing the following activities, as appropriate:

(a) Evaluation of the pre-feasibility study and environmental impact assessment (Step 2, Fig. 8-1, Annex 8);

(b) Conduct of the financial pre-qualification (Step 3, Fig. 8-1, Annex 8);

(c) Provision of input, as requested, into the technical evaluations by local experts (Step 4, Fig. 8-1, Annex 8);

(d) BOS cooperation with *voivodships* and *gminas* (Steps 5 & 6, Fig. 8-1, Annex 8);

(e) Review of GEF eligibility criteria at the central BOS office (Step 8, Fig. 8-1, Annex 8);

(f) Assembly of a financial package for the project (Step 10, Fig. 8-1, Annex 8); and

(g) Obtaining of approvals and signing of contracts (Step 11, Fig. 8-1, Annex 8).

7. The Applications Processing consultant would provide feedback to the Operations Handbook consultant, as appropriate, based on lessons learned from the above process.

8. **Task Two: Continue to Assist BOS in Administering the Selected Projects**. Once the first round of projects have been selected in the nationwide program, the consultant would continue to assist BOS in administering the selected projects, according to the activity sequence listed in Steps 12-19 of Figure 8-1 of Annex 8.

POLAND - COAL-TO-GAS CONVERSION PROJECT

Local Experts and Members of the Technical Advisory Groups (Terms of Reference)

1. Terms of Reference are defined here for two groups of consultants to assist boiler owners and Bank Ochrony Srodowiska SA (BOS) with the preparation and appraisal of project proposals. The first group (local experts) would assist the boiler owners in assessing the eligibility of project sites for GEF financing of boiler conversion from coal to gas and in formulating project proposals for regional BOS offices. The second group (Technical Advisory Groups) would assist central and regional BOS offices in appraising project proposals.

Local Experts
Scope of Work and List of Major Tasks and Deliverables

2. **Objectives**. Local experts/engineer consultants (or consulting firms) can assist prospective applicants for GEF funding in understanding the major advantages and responsibilities associated with participation in a GEF-funded project. These experts would provide low-cost assistance to boiler owners in assessing the relative attractiveness of their proposed projects and in defining the specific proposal best suited for the particular facility. BOS would maintain a roster of qualified consultants from which boiler owners could seek assistance.

3. **Qualifications**. The consulting firm or individual consultant assisting a boiler owner must have a valid license or registration to practice engineering in Poland and have satisfactorily completed a training program sponsored by BOS. The purpose of the training would be to assure that the consulting firm and/or the individual consultant: (a) understands the GEF project and the eligibility criteria and technology requirements; (b) has walked through a sample GEF application appraisal and implementation process; (c) can effectively assist interested boiler owners in determining whether the owners' facility may qualify; and (d) can assist boiler owners in complying with the procedures.

4. **Types of Services Required**. Assistance would generally be provided in the following steps.

Step a: Initial Consultation with the Owners. The consultant would advise owners on considerations and requirements related to obtaining GEF funding and to the longer term obligations for monitoring.

Step b: Screening Evaluation of the Proposed Project. The consultant would provide low-cost assistance in assessing the condition of boilers, structures and all associated facilities (heat transfer and distribution systems and energy user facilities served by the boilers) for suitability for GEF funding. This assistance includes consultations with owners, a review of documents and drawings and a walk-through inspection of the facilities. The consultant would prepare preliminary findings on the condition of the equipment, efficiency of operations, adequacy of maintenance and housekeeping, structural soundness, problem areas, access to gas service, and survey of environmental considerations. The consultant would develop simplified energy, fuel and water balances, including water leakage and wastes. The consultant would assess the emissions of sulfur dioxide, nitrogen oxide, particulates and carbon dioxide from the existing facilities. The consultant would also advise the owner on the specific type of conversion that would be best suited for a particular facility. The consultant would investigate and document all regulatory environmental requirements (local and national) that may have an impact on the project and, if necessary, prepare preliminary proposals for compliance. Finally, the consultant would assist the owner in assessing the relative attractiveness of the project proposal. This assistance would include preliminary estimates of the economics of the conversion project and its potential global benefits.

Step c: Decide on whether or not to Apply. Based on its findings the consultant would discuss with the owner whether the proposed project appears promising or not. If the project appeared promising, the process would move on to Step 'd' below. Otherwise the consultant would advise the owners not to apply for the GEF funding.

Step d: Complete the BOS/GEF Application forms. The consultant would assist the owner in completing BOS/GEF application forms.

Step e: Acquire Preliminary Financing Commitments. The consultant would assist the owner, as needed, in exploring preliminary financing sources for the local counterparts and obtaining commitments.

Step f: Complete Application Forms and File Forms with BOS. The consultant would assist the owner with these tasks.

Step g: Prepare Invitations for Proposal for Owner Representative and Assist with Contracting. Upon approval of the project proposal by BOS and STAP, the consultant would assist the owner in: (i) preparing the letter of invitation for proposal for the services of an owner representative in accordance with Bank guidelines; (ii) evaluating proposals received; and (iii) negotiating a contract with the selected owner representative.

5. The responsibilities of the local expert for an individual project would be considered to have been satisfactorily completed when the contract with the boiler owner representative becomes effective.

6. Funding of the Local Experts for Boiler Owners. During the project application phase (Steps 'a' to 'g'), the boiler owner would be responsible for covering the cost of the local experts.

Members of the Local Technical Advisory Groups (TAGs)
Scope of Work and List of Major Tasks and Deliverables

7. **Objectives**. Members of the local TAGs or local technical advisors (if a formal TAG has not yet been created) would assist BOS in implementing the GEF project at the local level, including evaluating project applications for GEF funding support. They would also assist central BOS office in various project implementation activities.

8. **Qualifications**. The required qualifications would be identical to those for the local experts (see para. 3 above). The Ministry of Environmental Protection, Natural Resources and Foerestry (MoE) would designate a short list of local experts and STAP would review their qualifications and approve their nominations as TAG members.

9. Types of Services Required. Assistance would generally be provided in the following areas:

(a) Assist BOS in preparing guidelines and forms for submitting GEF project proposals and application forms for funding.

(b) Assist BOS in appraising sites and facilities proposed for GEF coal-to-gas conversion projects and funding. This tasks includes independent inspection and verification of information on the equipment and structures and their condition, environmental considerations, availability and condition of utilities, and site access for facilities proposed for coal-to-gas conversion. The local expert/TAG member would review all documents prepared by both the owner and the local expert (see paras 2-6 above) and, if needed, provide feedback and request supplemental work from the owner and the local expert. The local TAG member/expert would use the cost-effectiveness criterion to advise local BOS offices of the priorities among conversion project proposals for GEF funding.

(c) Provide feedback to BOS and STAP on the practical problems encountered in applying the criteria STAP provided for project eligibility.

(d) In the case of projects approved for GEF funding: (i) review and advise BOS on proposed bidding documents for owner's representative contracts; (ii) assist BOS in evaluating bid and reviewing contracts being prepared for the services of owners' representatives; (iii) as necessary, review and advise on procurement matters; (iv) supervise installation and, on behalf of BOS, project implementation; (v) prepare progress reports, completion reports and other reports as necessary; and (vi) analyze technical and environmental performance monitoring reports.

(e) Where asked (this request should be rare) review and evaluate the performance of one or more of the local experts listed on the roster for assisting boiler owners in considering and proposing coal-to-gas conversion projects (see paras 2-6 above).

(f) Where asked, assist BOS in preparing: (i) informational brochures designed to assist boiler owners in applying for GEF support for coal-to-gas projects; and (ii) guidelines and forms for GEF applications.

(g) Where asked, provide training programs and/or training materials for local experts seeking to be placed on the roster of consultants available to assist boiler owners.

10. The services of local technical advisors and TAG members would be funded under the technical assistance component of this project.

POLAND - COAL-TO-GAS CONVERSION PROJECT

Marketing Plan
(Terms of Reference)

Objectives

1. The purpose of a marketing program for the GEF Coal-to-Gas Conversion Project is: (i) to make the GEF conversion concept known to potential interested boiler owners and others who can identify potential coal-to-gas conversions in small and medium-size heat-only-boilers combined with energy efficiency improvements throughout the heat supply chain; (ii) to make the GEF energy efficiency concept known to potential interested new residential building owners and developers and others who can identify potential energy efficiency measures in new residential buildings; and (iii) to encourage applications. The marketing plan is intended to identify potential "clients" of the GEF project and the specific actions, methods, resources and schedules needed to inform them of the GEF project and its benefits. The team to develop and implement the marketing plan should include expertise and experience in marketing energy-efficient, environmentally beneficial solutions to the types of clients and trade ally groups that would be involved in the GEF Coal-to-Gas Conversion Project.

Definition of Tasks

Task One - Identify Primary Potential Clients of the GEF Project

2. Purpose. The purpose of this task is to identify the general number and locations of the major types of owners of small boilers. This list would specify, for example, the percentage of prospective boiler conversion candidates that are publicly owned versus privately owned. Within each category (public and private) the magnitude of each type of candidate (such as hospitals, schools, apartment complexes, shopping areas and restaurants) would be identified.

3. For each major group, any special information channels to be used (such as periodicals, meetings and conferences) would be identified as would any characteristics of each key group that might influence its participation in the program. For example, who are the key decision makers? does the group have access money to help invest in the conversion?

4. Product. A section in the draft marketing plan would describe the general types, numbers and locations of potential public and private candidates for the GEF Coal-to-Gas Conversion Project.

Task Two - Identify Primary Allies for Marketing the GEF Project

5. Purpose. A number of groups in Poland might be possible "allies" of the GEF project because their group's objectives either overlap or are compatible with the objectives of the GEF project. Such groups could be very helpful in

informally marketing the program. Potential public and private ally groups include the following:

(a) Public: *Voivodships* and *gminas* would see in the GEF project opportunities to reduce local pollution and increase local equity at a low cost locally.

(b) Private: Several very different groups of potential allies exist:

(1) Several **energy, energy efficiency and conservation, and environmental foundations** that have overlapping environmental objectives;

(2) **Boiler manufacturers**, which might see potential large new markets for themselves through in-country manufacturing and sale of new high-efficiency gas-fired technologies;

(3) **Manufacturers/distributors of energy products for buildings**, which might see opportunities to increase the market penetration of their locally made or locally supplied products, such as insulation, foam insulation sealants, high-efficiency windows, lights, ballasts, or electric appliances.

6. **Product**. A section in the draft marketing plan would identify potential public and private sector allies, including the number, size and distribution of each group. For each group, the section should provide a plan for garnering its support in marketing the GEF project, including: (a) why each group could become an ally; and (b) what marketing measures could be used to maximize its contribution.

Task Three - Develop Marketing Strategies

7. **Purpose**. A number of possible marketing strategies have been identified and are listed below. The purpose of this task is to develop these strategies in more detail, including specific plans for accomplishing them.

(a) Written Advertising: in newspapers, relevant technical magazines and publications likely to be read by interested groups (such as housing cooperatives, schools and hospitals):

(1) ***Posters:*** High-quality visual images promoting the benefits of the program, with key concepts and addresses, telephone and fax numbers of points of contact;

(2) ***Magazine articles:*** A series of pre-written articles or parts of articles that can be used "as is" or adapted by various magazines and organizations;

(3) ***Newspaper articles:*** The same intent as with the previous set

of articles, but for adaption by newspapers in conjunction with upcoming new events or with local "features." These tend to have less detail than magazine articles.

The specific target audiences should be identified for each type of product. In some cases, the target audience would be reporters, writers and editors, for example, the environmental editor of each major newspaper and magazine. Telephone discussions should be held with these people to determine their needs.

A general description of the program, including the specific criteria for the inclusion of boilers in the GEF Coal-to-Gas Conversion Project, would be clearly written and, upon approval by all parties, made available for distribution to contacts being made under the marketing plan.

(b) Radio and TV advertising: this advertising could include, for example, a mini-series on national television. This approach is considered an excellent means of making project objectives, criteria, procedures and benefits widely known throughout Poland. Existing TV and video material on air pollution program and the like should be identified and explored for applicable use by the GEF program marketing effort. A TV series might, for example, consist of three 15-minute presentations.

(1) A general discussion of air pollution issues, the role of greenhouse gases and the potential impacts on global warming;

(2) A description of the overall GEF program, and how the GEF Coal-to-Gas Conversion Project in Poland fits within this program. The objectives of the GEF Coal-to-Gas Conversion Project would be presented, along with its potential impacts and benefits. The pilot projects in Krakow would be introduced; and

(3) More detail about the pilot projects in Krakow and a detailed description of the criteria for qualifying for funding under the GEF project, along with details of the procedures for applying;

(c) Brochure: prepare a clear, simple explanation of the project's objectives and benefits, with typical examples of applicable projects and a clear discussion of the application criteria and procedures;

(d) Meetings with potential allies: develop strategies for meeting with potential allies in marketing the project and identifying viable potential projects. The meetings can include seminars and presentation materials. Development of this strategy should address whether separate materials are needed for different audiences, such as:

(1) ***Voivodships, gminas and district heating enterprises:*** presentations or seminars on the project would be desirable to local, regional or national meetings of *voivodship* representatives, district heating system representatives, inspectorates dealing with control monitoring and approval of technical installations, and the *voivodship* environmental units. Presentations would also be directed to other key identified groups at meetings and conferences;

(2) ***Manufacturers:*** determine how manufacturers perceive the GEF project. Specifically, do they see the program as having market potential for them? For example, a strong side-benefit of the GEF project would be the development and strengthening of in-country capabilities for designing and producing high-efficiency gas-fired production technologies such as condensing boilers and co-generation systems. The marketing plan might be implemented with this potential side-benefit in mind. Typically, but not always, smaller firms are more open to innovation than the large firms that dominate the existing markets; and

(3) ***Private sector groups:*** hold meetings with relevant private associations such as architects and engineers.

It is suggested that the Ministry of Environmental Protection, Natural Resources and Forestry (MoE) and the Bank Ochrony Srodowiska SA (BOS) make a list of suggested initiatives for further development.

8. **Product**. A section in the draft marketing plan would describe each likely strategy in sufficient detail to permit the strategy to be properly accomplished.

Task Four - Develop Draft Marketing Plan

9. **Purpose**. Based upon the results of the activities in tasks 1, 2 and 3, a draft marketing plan would be developed, to include a proposed budget and schedule for the proposed marketing activities. Key elements would be implemented at the earliest possible time.

10. The marketing plan might consider full dissemination of information throughout Poland or a focus primarily on selected regions. For example, one option for marketing might be to prioritize the marketing efforts in the following stages:

(a) emphasize the heavily polluted southern industrial region;

(b) emphasize other heavily polluted areas already identified by MoE;

and

(c) market the remaining areas of the country.

Rationales for the various approaches should be given.

11. **Product**. A report should enumerate the results of this task, including the results of Tasks 1, 2 and 3 as separate sections or annexes. In addition, the results of Tasks 5 and 6, described below, should be included as annexes to the draft marketing plan report.

Task Five - Develop Drafts of Key Marketing Documents

Task 5.1 - Develop a Draft of a Project Brochure

12. **Purpose**. Develop a draft of the proposed project brochure and test it for clarity and readability. Important parts of the brochure are clear statements of project objectives, eligibility criteria, procedures and benefits. The draft brochure should be revised based upon the results of the tests for clarity and readability.

13. **Product**. A copy of the draft brochure would be included as an annex to the marketing plan.

Task 5.2 - Develop draft of TV series

14. **Purpose**. Develop a draft approach to the development of a TV series. This draft should be prepared early, given the potential importance of this vehicle for widely explaining the project throughout the country. The draft should identify resources, budgets, schedules, quality levels, and the like and should lay out a draft sequence of presentations.

15. **Product**. The copy of the draft approach should be detailed enough to obtain early approval for the next development steps.

Task 5.3 - Develop draft of seminar agenda

16. **Purpose**. Develop a draft of a proposed seminar agenda that can be widely used to introduce material at meetings with various public and private groups. This effort should assess the level of details such presentations might require. The draft agendas should indicate the possible audiences for each.

17. **Product**. A copy of the draft agenda(s) would be included as an annex to the marketing plan.

Task Six - Develop a Database of Contacts

18. **Purpose**. As part of each of the above five tasks, but in particular tasks 1 through 3, develop and maintain a list of contacts by type, including names,

positions, addresses, and telephone and fax numbers. Use of a PC-based spreadsheet, database program or personal information manager should suffice.

19. Product. A copy of the database of contacts should be available in hardcopy and diskette form, delivered as a separate annex to the marketing plan.

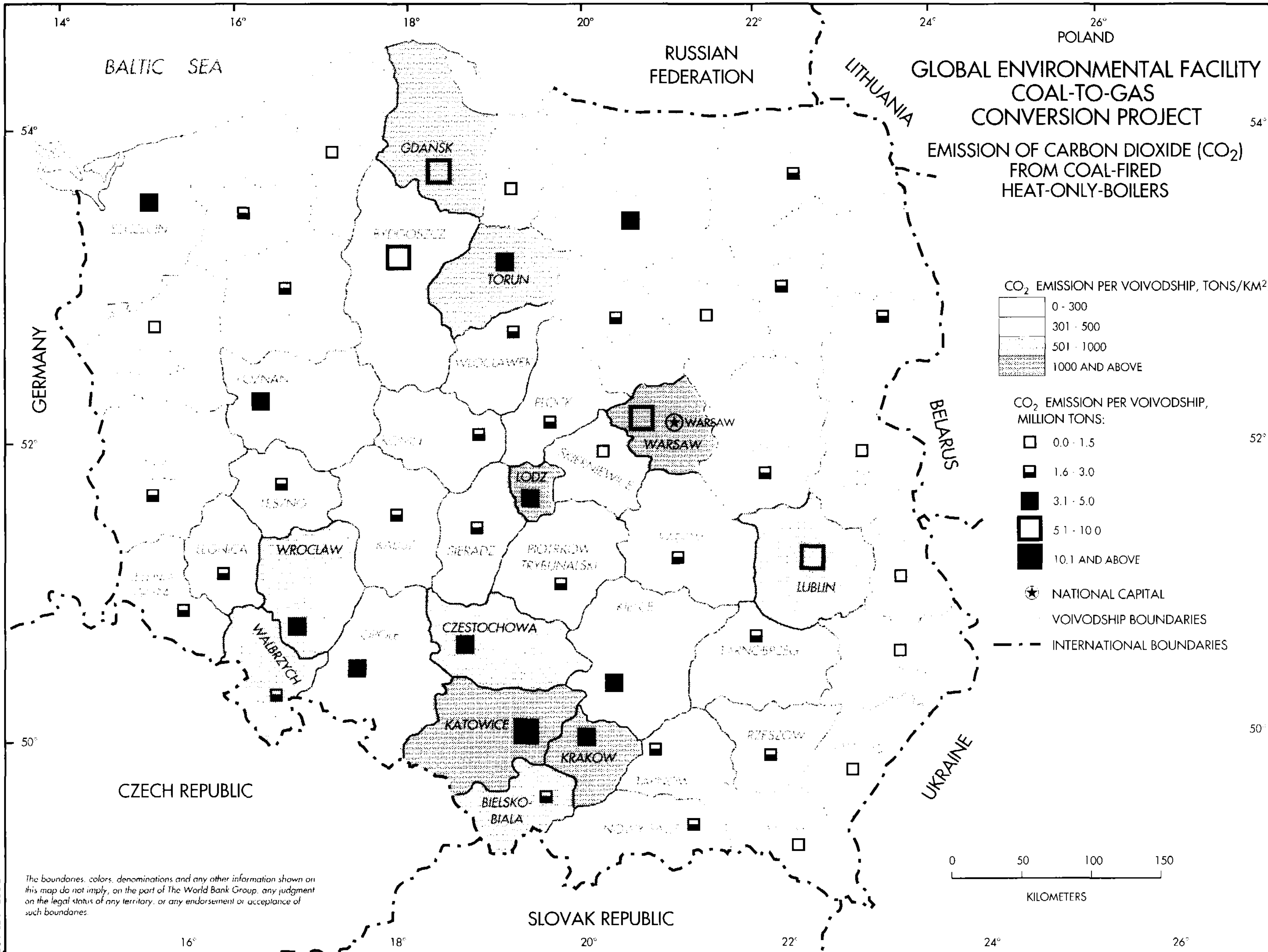
Task Seven - Independent Evaluation of the Individual GEF Projects

20. Purpose. The purpose of this task is to use, at a later stage of GEF project implementation, testimonials from boiler owners who have gone through the process and are willing to speak about their experience as beneficiaries of the GEF fund and as owners/operators of new facilities with innovative and high-efficiency gas-firing technology. Means for gathering such testimonials such as a standard questionnaire and individual interviews should be developed. These testimonials could be complemented with project site visits organized for national and local policy groups, technical and professional associations, other GEF applicants/prospective beneficiaries, students, foreign visitors and so on. For example, completed GEF projects could serve as a training center for promoting new energy efficiency technologies.

21. Product. A section in the draft marketing plan would describe the likely strategy in sufficient detail to permit the strategy to be properly accomplished.

Budget for Implementing the Marketing Plan

22. Under the proposed project, an estimated budget US$150,000 has been allocated for implementing the marketing plan, including the development of a nationwide TV promotion program for the GEF project.



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