

Report 1994:7

**World Bank Appraisal Mission to Poland May 31
to June 11, 1993***

The GEF Coal-to-Gas Conversion Project

by

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1. BACKGROUND

Poland's energy economy is dominated by coal, which is domestically produced. Even though the industrial structure is biased towards energy and coal intensive industries, the share of coal is artificially high. The related pollution problems are enormous. Some estimates put Poland as the world's eight largest producer of carbon dioxide.

The share of coal was 77% in 1991, while the share of oil and gas was 21%, one of the lowest in continental Europe. A shift towards an oil and gas share of 53 to 73% is estimated by the World Bank to lead to at least 50% reduction in the carbon dioxide emissions.

One of the reasons for the widespread use of coal is the use for space heating. The use of gas for space heating was earlier prohibited and the use of oil was held back by various measures. The aim was to limit foreign exchange expenditures on energy imports. Coal for space heating is used both in district heating systems, block heating plants (heating several apartments) and in individual heating in stoves. District heating companies own about 16 GW coal fired boilers, consuming about 6 million tons of coal per year. About 3,2 GW of this capacity is, by the World Bank, considered suitable for replacement with gas fired boilers.

Removal of the direct regulation of fuel use will result in a shift from coal to gas or oil. Coal will for reasons of price remain the preferred fuel for relatively large boilers, where economies of scale offsets the higher costs of coal handling and emission control equipment. Also in small boilers, coal has until recently been the preferred fuel for economic reasons, but higher coal prices will reduce its use in the long term.

Environmental standards has been and will be further strengthened for sulphur, particulates and nitrogen oxide, and effective enforcement will be phased in over many years. This will accelerate the price-driven conversion of small boilers from coal to gas. The emission standards are administered by local authorities, and linked to these, is a system of fees and fines. Emissions of sulphur dioxide, nitrogen oxides and particulates, as well as carbon dioxide are taxed. The fees on carbon dioxide are only of symbolic nature. (One zloty per ton of emissions). The other fees could have some albeit small effects on conversions from coal to gas.

There are several obstacles to conversions from coal to gas. They include lack of access to financing, budgetary procedures of publicly owned heating companies, and lack of price incentives. Cost savings in heat production are not felt at the consumers end because heat prices are subsidized. Only the local authorities have a well defined interest in reducing costs, but often lacks the financial means for investment.

For the immediate future, the conversion of coal to gas will not be financially attractive without taking into account the global warming considerations and/or local pollution effects.

2. THE GLOBAL ENVIRONMENTAL FACILITY (GEF)

A priority of GEF is to assist in reducing emissions of greenhouse gases. One of the least-cost options for reducing carbon dioxide emissions in Poland is to encourage a more rapid transition from coal to gas.

GEF is distinguishing between three types of investments which generates both domestic and global benefits. This coal-to-gas conversion project belongs to type three: "The investment is justified in a country context, but the country would need to incur additional costs to bring about additional global benefits. The additional costs of accommodating global concerns would be eligible for GEF funding, provided they are within the cost-effectiveness guidelines."

3. THE GEF COAL TO GAS CONVERSION PROJECT IN POLAND

The project will encourage coal to gas conversions for small to medium-sized heat plants (boilers). It will also seek to demonstrate the value of increased end-user efficiency through improvements in a new residential complex.

The total financing plan for the project is US\$ 52 million, of which the local counterpart funding is US\$ 26 million. The total amount of grant is US\$ 26 million of which US\$ 25 million is from the GEF and US\$ 1 million a cofinancing from the Government of Norway. The grant is for the Government of Poland, represented by the Ministry of Environmental Protection, Natural Resources and Forestry. The Bank for Environmental Protection (Ecobank) is chosen as the implementing agency. Apart from the legal arrangements between the World Bank and Poland, a bilateral agreement will be made between the Governments of Poland and Norway.

During project preparation preliminary results showed that, without GEF financing, the rate of return for typical coal-to-gas conversion projects ranges between 2 and 8%. To achieve a rate of return in the range of 15 to 25%, the GEF concessional financing should cover about 40 to 70% of the total project cost, corresponding to a cost effectiveness of the GEF related incremental cash flow of the project lifetime of US\$ 15 to 70 per ton removed carbon dioxide.

4. OBJECTIVES

The project-specific objectives are:

- a) to decrease emissions of carbon dioxide;
- b) to introduce the technology of gas-fired boilers for production of heat and electricity in exchange for coal-fired boilers;
- c) to build the institutional capacity for technological change and improvement of energy efficiency; and
- d) establish an organizational structure for replicating the GEF concept to other investment projects yet to be identified nationwide.

The Parties to the Framework Convention on Climate Change have i.a. agreed that policies and measures to reduce greenhouse gas emissions may be implemented jointly with other countries, Parties to the Convention. The criteria for the mechanism of joint implementation are, however, yet to be developed and decided upon by the Parties. On this background, the Norwegian Government has decided to cofinance this GEF project, which might serve as a practical demonstration project for important elements of a joint implementation scheme.

5. PROJECT DESCRIPTION

5.1 The baseline scenario

For defining the GEF contribution, it is necessary to define the baseline scenario or the reference situation. For this project, it is: a) continued use of the existing boilers or b) an estimate of a mix between a), new coal-fired boilers and gas-fired boilers.

As many boilers are old, new investments will have to be made over the next years. New coal-fired boilers are readily available in Poland. Without external financing, the predominant choice of technology would for many years ahead seem to be the coal-fired boilers .

However, as new environmental standards already are introduced and are to be phased in over the next few years, the conversion to gas is not unlikely for many boilers owned by the state or the municipalities. The costs of conversion to oil/gas may also be assisted through national subsidies from the revenue of fees and penalties of pollution. This is especially the case in the heavy polluted areas, where conversion to gas will have significant impact on the local health and environment. This is also in line with the Polish policy as a signatory to the FCCC.

Even if the economics of conversions to gas-fired boilers may seem to give a low rate of return for some time to come, the above mentioned elements would indicate that the most correct baseline scenario might be a mix of old and new coal-fired boilers and new gas-fired boilers. This illustrates the difficulty in defining a baseline scenario. With the uncertainties of the current situation in a country like Poland, which is undergoing a major process of restructuring, it is perfectly possible to draw up a variety of valid baseline scenarios. In addition, it would probably be difficult to obtain universal agreement on a single baseline. The continued use of existing coal fired boilers (the business-as-usual scenario) was chosen as the baseline scenario.

In addition to the projects directly supported by the GEF-funds, one would also expect that the replicability effect of the project results in a generally higher speed of conversion from oil to gas. The reduction effect of this process is not estimated.

5.2 Criteria for the selection of projects

The beneficiaries of GEF assistance would be non-industrial public and private institutions or enterprises. GEF assistance will seek to demonstrate inter fuel substitution possibilities and technological innovation, combined with improvements in overall energy efficiency as means of reducing carbon dioxide emissions. In order to comply with the general GEF criteria and to adapt to the specific Polish situation, the following rules have been adopted for selection:

- * Only small and medium sized heating plants which can not be eliminated and connected to a district heating system qualify. There are other programmes in place for converting district heating systems from coal to gas.
- * Only projects using technologies mentioned below, would normally qualify. A coal-to-gas conversion using a standard gas boiler would not qualify.

The chosen technologies include cogeneration of heat and electricity and condensing gas boilers. Cogeneration of electricity and heat with a gas turbine or gas engine has the advantage of reducing carbon dioxide emissions both at its site and by replacing coal in the central generation of electricity. Natural gas cogeneration and condensing boilers are proven technologies in the West, but are new technologies to Poland. Cogeneration of electricity and heat is in Poland based on coal fired plants only. Cogeneration is therefore currently only taking place in major plants.

Also housing energy efficiency projects are included in the definition of projects eligible under the GEF criteria. This so-called total energy housing concept include energy efficiency considerations in all stages of design and choice of construction materials etc. Only new housing complexes are eligible to GEF grants.

5.3 National incentives

The selection of projects will also depend on local priorities, mostly based on local environmental benefits and the capability to produce the national/local counterpart financing component.

The project will give **global environmental benefits**, thus also including benefits for Poland. Poland is, as a signatory to the FCCC, committed to contribute to the objectives of the Convention.

National environmental benefits from the project are reduced emissions of sulphur dioxide, nitrogen oxides and particulates. It will reduce the impacts of acid rain, which concerns both the national and regional environment. The reductions will also improve the local air quality and give positive health effects and less damage to crops, vegetation and buildings. Priority in Poland has been given to reduce emissions from big power plants, from major industries and large district heating plants. The reduction of emissions from small plants resulting from the GEF project is supplementary to the current national policies.

One of the objectives of the GEF is to provide assistance to the **transfer of new technologies** to the recipient countries. By funding investments in technologies which are well proven and tested in the West, but are new to the recipient country, the project provides the benefit of dissemination of technical knowledge. It should be stressed, however, that the dissemination effect is only feasible if the economies of the technologies are such that investments are profitable on their own merits. Small scale cogeneration units on gas are in the West not universally profitable, but may be profitable in Poland, depending on local circumstances. Condensing boilers are generally not profitable compared to traditional boilers given the current energy prices. Both technologies could however, prove to be economically feasible in a situation of higher energy prices.

A generic criteria of the GEF is to **extend the knowledge** of the concept of the GEF assistance and that the selection and assessment of projects shall be made at the local level. It was agreed that the process shall involve a public review of suggested projects as well as their Environmental Impact Assessments at the municipality level. The Voivodship (The Regional State Authority) will also be participating in giving priority to the eligible applications on the basis of their local environmental benefits. The Voivodships will also consider giving financial support. Assessments of applications will be performed by the implementing agency with the assistance of a local expert group. Applications which are turned down at the local level will not proceed to the central level. Experts taking part in the technical preparation of projects will be invited to participate in reviewing the projects.

5.4 The Pilot Projects

The World Bank has examined a variety of options for initiating the GEF project. Because of lack of reliable data on the existing stock of small and medium sized boilers, it was not feasible to establish a list of projects, which *a priori* would meet the GEF criteria. Instead it was decided to choose a few pilot projects, which could serve as demonstration and also provide experience in the administration and management of projects. Before the last appraisal mission, three projects in the Krakow region were retained:

- * a total energy housing concept for a new residential apartment block;
- * a condensing boiler for a commercial/residential building; and
- * a cogeneration unit based on gas supplying heat and electricity to the University of Polytechnics.

The specific total energy housing concept could, however, not be retained. The chosen site was actually developed with individual gas heating. The precarious situation of new apartment construction in Poland will make it difficult to identify suitable projects.

The boiler conversion projects, on the other hand, have attracted interest and meets with the criteria of GEF. These two projects and their estimated effects, are described in annex 5

5.5 Incremental cost calculation

The GEF assistance will provide the incremental funding to either make the individual projects with global benefits economically viable, or to modify already viable projects to enhance the capturing of such benefits. The funding will provide incentives to undertake the conversion from coal to gas firing for boilers, whose owners could not achieve acceptable rates of return without concessional funding.

Economic analysis of the two pilot projects showed that they, without GEF grants, would be unprofitable. In a Western type economy, a yardstick for profitability would be to test if the projects give an internal rate of return (IRR) in line with current commercial bank's lending rates plus an allowance to cover the risks taken by the investor. In Poland's economy a more judgmental method has to be followed, as there are important imperfections on the capital market.

The World Bank has suggested that the GEF grant should secure an IRR on the investment to arrive at 15% (real rate of return). To determine the GEF contribution, for each project, a cash flow analysis over the project lifetime will be carried out, and the GEF contribution determined so to meet the target IRRs. This is however highly dependant on the baseline scenario. The baseline should represent the investment that are economically viable from the countrys point of view without external funding and global considerations. The chosen baseline scenario is the continued use of coal fired boilers.

5.6 Cost-benefit analysis

For each individual project meeting the GEF criteria a full analysis of the financial feasibility, the local environmental impacts and the global costs and benefits will be undertaken.

Because of the difficulties in defining appropriate costs for the damage caused by emissions of sulfur dioxide, nitrogen oxide and particulates, it was, during the mission, agreed only to include avoided environmental fees in the cost benefit analysis. The environmental fees levied in Poland are probably lower than the costs of damage caused by the pollutants. This implies, that the cost benefit analysis underestimates the total benefits of the programme.

The costs of reducing carbon dioxide emissions are in the project calculated by comparing costs over the lifetime of the investments in the baseline with the costs resulting from investing in a new technology resulting in lower carbon dioxide emissions. The cost comparison between the baseline and the projects is made by implying that energy prices and all other cost factors remain at current levels. Alternatively, the cost calculations could be made by using forecast values for energy prices and other costs over the lifetime of the project. There is, however a host of problems in making and obtaining an agreement on a forecast of energy prices. The method of using current energy prices constitutes a compromise.

5.7 Financial plan

A financial analysis of the condensing boiler project, shows that it needs a grant of US\$ 200.000 in order to produce an IRR of 15%. The grant is equalivant to a grant of US\$ 32 per ton of reduced carbon dioxide emissions when comparing the emissions from a continued use of the existing coal fired boilers. A financial analysis of the cogeneration project, shows that it needs a grant of about US\$ 3 million to secure an IRR of 15%. The grant corresponds to US\$ 69 per ton of reduced carbon dioxide emissions per year.

For the two pilot projects, an indicative financing plan was discussed with the owners, the National Fund, the Ecobank and the Voivodship. The World Bank insisted on a minimum owners contribution and firm commitments from the other counterparts without public guarantees. This financing scheme for the two main types of technologies is shown in table 1.

This financial plan could serve as a master for the entire GEF project. The counterpart funding is expected to be mainly subsidized loans from the National Fund/Ecobank, both drawing on resources from pollution fees and penalties from industry, from the Voivodships and a small part from the boiler owners.

Table 1

Financing sources	Technology	
	Cogeneration	Condensing
Cost per project (thousand. US\$)	4.860(100%)	385(100%)
Grant	3.050(63%)	200(52%)
Counterpart funding	1.810(37%)	185(48%)
Typical counterpart split		
National Fund/Ecobank	1.458(30%)	147(38%)
Voivodship	109(2%)	0
Minimum owners contribution	243(5%)	39(10%)

5. 8 Calculated global effects

The WB has calculated the so called Global Performance Ratios. For each project this ratio is calculated as the present worth of incremental costs (investment and operating costs) associated with the projects divided by the discounted sum of the yearly reductions of carbon dioxide emission achieved by the proposed investment. A project lifetime of 17 years and a 15% discount rate were used. The results are shown in table 2.

Table 2

Global Performance Ratios (US\$ per ton of carbon dioxide reduced)		
Baseline scenario	Condensing boiler	Cogeneration
Business-as-usual	32	69

These ratios are low compared a typical one for Norway of about US\$ 200 per ton of carbon dioxide reduction, and demonstrate the cost effectiveness of implementing a joint strategy for reducing carbon dioxide.

5. Institutional structure

A draft executive summary of the appraisal mission report is enclosed as annex 3. This annex also include, the draft project structure and a draft flow-chart. The Norwegian consultants advocated a simpler structure. This was also the view of the Polish authorities, and the enclosed structure is therefore expected to be somewhat changed. The organizational framework is designed not only to accomplish the pilot projects, but also so that this structure and resources can be used to replicate similar future projects. Also, personnel with experience from the first projects may assist in replicating the process in other regions in Poland.

The role of the Ministry for Environmental Protection, Natural Resources and Forestry is to have the overall responsibility for all project activities, including those of the implementing agency, the Bank for Environmental Protection (Ecobank/BOS). The Ministry will 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.

As implementing agency, the Ecobank has multiple roles and responsibilities both during project setup and during the implementation phase. Ecobank will develop and refine standardized procedures and forms for replicating projects, develop and implement a marketing plan, and organize technical assistance activities for Ecobank national and regional staffs, for the Technical Advisory Panel, for the local experts, for the Voivodships, and for the Ministry staff. The Ecobank will also have a primary role in collateral funding for GEF projects at market interest rates, at subsidized rates, or both. Most GEF projects will be within funding limits set for subsidized rates. The Ecobank will negotiate funding packages for the projects together with the National Fund and the Voivodships. The Ecobank will submit quarterly progress reports to Ministry and the World Bank summarizing project status, including funds committed and spent, and projected and obtained results.

The role for the Technical Advisory Panel is to review all projects for compliance with technical requirements and also to assess the cost-effectiveness in conjunction with Ecobank. The National Fund for Environmental Protection and Water Management will have a role in collateral funding for GEF projects, either through direct contribution via loans from the National Fund, or via subsidies on interest rates for loans provided by Ecobank. The Voivodships could be a source of funds to projects at the local level. Many Voivodships have substantial funds from their share of environmental fees and fines levied. The owners of boiler to be converted will often be local public institutions rather than private.

In addition, funding from commercial banks at market rates will be sought to complement funds from the above institutions.

5.10 Verification and monitoring of results

As soon as a contract for participation in the coal-to-gas conversion programme is signed, the boiler owner is obliged to start monitoring GHG emissions as well as other pollutants. A monitoring design will be an integral part of the concept of the projects supported under this programme. The Inspectorate for Environmental Protection will establish a process of verification of systems operation, cost-efficiency and monitoring of emissions. This "verification" process might be yearly for all projects or of some projects chosen randomly.

5.11 Project sustainability

To obtain a maximum replicability of the two pilot projects within the GEF project, it was agreed that a strong marketing effort should be initiated to make the GEF concept known to boiler owners and others who can identify potential conversions and encourage applications. A number of marketing strategies were discussed. These include for example advertising, making brochures, meet the boiler manufacturers, give presentations to other key groups, and have meetings with relevant public institutions concerned. The Ministry and the Ecobank will develop a marketing plan to be implemented at an early stage. The plan should be developed in detail prior to the project negotiation.

The ECOFUND (The Polish Debt for Environment Swap) may be a major source of funds to assure sustainability and extension of the GEF project objectives. Because ECOFUND provides grants on a somewhat similar basis to GEF, and with global considerations it may collaborate with GEF also to fund coal-to-gas conversion projects that are non-economical from a national perspective. ECOFUND may also choose to fund future projects after the GEF project is completed, thus providing post-GEF project sustainability for technologies that have not yet become economical by the end of the GEF project.

6. CONCLUDING REMARKS

A draft Executive Summary of the Appraisal Mission Aide-Memoire was discussed with the Polish authorities. The final Appraisal Mission Aide-Memoire will be confirmed by the World Bank by June 30. A number of actions will have to be taken by the Polish authorities prior to negotiations in Washington, expected to be in mid-October.

The acceptance letter of Norwegian cofinancing should be sent before August. This issue has been discussed with the Ministry of Environmental Protection and they will take the initiative of approaching the Norwegian authorities.

The financing plan concerning the local contributions proved to be very difficult to establish as firm commitments could not be obtained. This counterpart commitment is now a requirement for negotiations. The administrative structure is, in our opinion very complicated and it was, after internal discussions, agreed to indicate to the Polish authorities the willingness to agree to a much simpler structure. Some important technical issues, critical to the project implementation, came as surprises, but were solved during the mission.

The difficulty encountered in defining a baseline for carbon dioxide emissions needs to be stressed. The possibilities for continued use of coal in small boiler installations depend on energy prices, taxation, nation-wide as well as local environmental rules and the practical enforcement of such rules. Some of these factors are bound to change over time and the baseline will consequently also change. The GEF programme has independently of these conceptual and practical difficulties the advantage of accelerating conversions from coal to gas by providing financial assistance. It could also entail an increased penetration of new and efficient technologies because of the demonstration effect. It would however, be extremely difficult to define any carbon dioxide credits unequivocally for donor countries derived from such a scheme.

Annex

Further information on the two pilot projects in Krakow

The condensing boiler project is located in the historical centre of Krakow. The owner is the local district heating company. There is currently 2.1 MW in place of coal fired boilers for heat supply of a commercial/residential complex. The existing boilers are more than 25 years old. It is estimated that the boiler efficiency is only 50%. The project include conservation measures at the consumer level (thermostatic valves and pipe insulation). The existing boilers could be replaced by new coal fired boilers, new gas fired boilers without condensing or with condensing gas fired boilers. They would all have higher efficiencies than the existing boilers. Condensing boilers have the highest efficiency due to the recuperation of vapour heat in the flue gas. The vapour in the flue gas is condensed and the heat recuperated by a heat exchanger. Reduction of carbon dioxide emissions compared to the existing situation are as presented in table 1.

Table 1

Type of technology	Per cent reduction of CO ₂ emissions per year	Tons of reduction of CO ₂ emissions per year
New Coal boilers	36	547
New gas fired boilers	64	978
New condensing gas boilers	68	1041

The cogeneration project is located at the University of Polytechnics in Krakow, which is the owner. There is currently in place a 10 MW coal fired boiler complex, which could be replaced by new coal fired boilers, new gas fired boilers, new condensing gas fired boilers or a combination of a cogeneration unit and boilers. The existing coal fired boilers have an efficiency of 64%. The cogeneration solution is the favoured because of its advantages in terms of energy efficiency improvements and reductions of carbon dioxide emissions. The waste heat from a gas turbine producing electricity is used to heat water for the central heating system. About one third of the energy production from the cogeneration unit will be electricity, which is in part to be sold to the public network and in part will cover the university's own electricity use. The generated electricity will reduce the use of coal in the public electricity supply system. The reduction of carbon dioxide emissions compared to the existing situation is presented in table 2.

Table 2

Type of technology	Per cent reduction of CO ₂ emissions per year	Tons of reduction of CO ₂ emissions per year
New coal boilers	18	1186
New gas boilers	54	3577
New condensing gas boilers	59	3928
New cogeneration with gas	n.a.	7352

The carbon dioxide emissions from the plant's use of gas are smaller than the avoided carbon dioxide emissions from less coal use in the public electricity supply system. The percentage reduction in carbon dioxide emissions compared to the baseline is therefore not defined.

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