Good Practices in Policies and Measures for Climate Change Mitigation

A Central and Eastern European Perspective

THE REGIONAL ENVIRONMENTAL CENTER
for Central and Eastern Europe

WORLD RESOURCES INSTITUTE

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Introduction

Background

Under the United Nations Framework Convention on Climate Change (the Convention), parties have common but differentiated responsibilities in mitigating global climate change. The industrialized countries and the countries with economies in transition (EITs) included in Annex I[1] of the Convention have made a significant contribution to atmospheric accumulation of greenhouse gases (GHGs) in the past and, therefore, have special responsibilities to limit or reduce their emissions. Towards this end, Annex I parties have agreed to adopt national policies and take corresponding measures in their countries to mitigate climate change.[2] Such policies and measures should help Annex I Parties achieve the quantified emission limitation and reduction objectives they have assumed under the Kyoto Protocol to the Convention.[3]

Unlike the compliance requirements and other provisions contained in the Kyoto Protocol, implementation of domestic policies and measures does not require the agreement of international rules beyond the general provisions of Article 2 of the Kyoto Protocol. Parties can, therefore, initiate domestic actions to reduce emissions or to enhance sink capacities and monitor their impact, without further international action. By doing so, they will increase their ability to meet their emission control targets (see Table 1) once the Kyoto Protocol enters into force. More importantly, the parties will make an immediate contribution to reducing overall GHG emissions and countering the threat of climate change.

The Convention and the Kyoto Protocol suggest that national policies and measures should include enhancement of energy efficiency and carbon sinks, promotion of renewable forms of energy and sustainable agriculture, and relevant sectoral reforms.[4] In its recent report, the Intergovernmental Panel on Climate Change (IPCC) defines a more specific set of policies and measures, including emissions, carbon or energy taxes, tradable and non-tradable permits, subsidies, voluntary agreements, technology and performance standards, product bans, and direct government spending such as investments in research and development. There is no agreed-upon definition of

TABLE 1

Comparison of base period GHG emissions (carbon dioxide, nitrous oxide and methane in gigagrams of CO_2 equivalent) **with 1998 emissions levels**

Country	*Base Period*	*Reduction target*	*Base period emission $GgCO_2eq/yr$*	*1998 emissions*	*Percent change*
Bulgaria	1988	8%	157,090	83,671	-46.7
Czech Republic	1990	8%	189,837	147,777	-22.2
Hungary	1985-87	6%	101,633	82,725	-18.6
Poland	1988	6%	564,286	402,477	-28.7
Romania	1989	8%	264,879	No data	No data
Slovenia	1990	8%	19,212	No data	No data

Source: UNFCCC <http://ghg.unfccc.int/>

what constitutes policies and measures to mitigate climate change. The Kyoto Protocol and the IPCC report rather list desirable outcomes, including improved energy efficiency, a greater share of renewables and instruments that can potentially lead to voluntary agreements or product bans.

This report examines activities implemented by six EITs in Central and Eastern Europe[5] (CEE) to reduce or limit their emissions of greenhouse gases (GHG). All six countries are parties to the Convention, and all but Hungary have signed the Kyoto Protocol. One of them — Romania — has already ratified the Kyoto Protocol, and the Czech Republic, Hungary, Poland and Slovenia are planning to do so before the end of 2002.

The report seeks to test a set of criteria for assessing "good practices,"[6] within the range of domestic policies, measures and projects to reduce GHG emissions in these six Annex I countries. It shares findings from the application of these criteria to a set of very diverse activities in the selected EITs in Central and Eastern Europe. Given CEE countries' similar circumstances and common aspirations for transition to a market economy and integration with the European Union, the conclusions from the six national case studies also identify good practices and appropriate actions relevant to the whole region.

The section on methodology describes the evaluation criteria and the process of their development. Our hope is that the assessment criteria will be a useful source and information for other Annex I and non-Annex I countries in making decisions on climate change mitigation activities according to their national circumstances.

The bulk of this report presents the findings from the case studies.

In Bulgaria the case study applies the evaluation criteria to assess municipal and residential energy efficiency measures. It demonstrates that small-scale measures at the municipal level have a high potential to reduce GHG emissions and that local governments have a significant interest in climate-change mitigation efforts as well as a critical role in making them happen.

The case study in the Czech Republic focuses on government-planned mitigation measures in the transport sector. It suggests that not all planned measures will reduce GHG emissions from transport and that priorities for developing the transport sector need to be reviewed.

The Hungarian case study examines an energy efficiency credit line. It demonstrates that government spending is not as effective in reducing GHG emissions as macroeconomic reform designed to improve overall economic efficiency. Earmarked soft financing, however, complements macroeconomic reform by achieving emissions reductions and efficiency gains primarily by the public municipal sector, whose response to microeconomic reform is slower.

The Polish case study applies the criteria at two levels: climate mitigation policies defined by the government in the Polish National Communication, and small and medium renewable projects to implement the Polish government's objective of increasing the share of renewables in the energy mix. It shows that the price of reducing a ton of GHG emissions is relatively high and variable, and that renewables are not currently competitive as compared to conventional sources of energy. Soft financing, fixed obligations to purchase renewables and conditions designed to improve competitiveness will increase the share of renewables and improve their competitiveness vis-a-vis traditional sources of energy.

In Romania, the criteria are applied to two combined heat and power (CHP) district heating plants. One is a small-scale, public-private partnership, and the other is a large-scale, government-owned facility. The study demonstrates that the myriad benefits (e.g., in environmental, economic, social and institutional terms) of this small-scale CHP project may be a "good practices" candidate; the large-scale CHP project failed to generate sufficient evidence to draw any substantive conclusions.

In Slovenia, carbon dioxide (CO_2) tax exemptions, the high CO_2 tax level compared to other taxes and the uncertainty created by the electricity and energy market requirements for EU accession undermine the potential positive impact of the CO_2 tax on decisions for new CHP installations.

The concentration of the case studies on the energy and transport sectors reflects the scale of these sectors' contribution to the overall emissions of CEE countries; the high energy and GHG emission intensity of the residential and district heating sector; and the rapid growth in emissions from transport. In Romania, for instance, the residential sector's share of overall energy consumption doubled between 1989 and 1994, whereas the share of industrial consumption declined during the same period.[7] The case studies also attempt to test policies and measures recommended by the Kyoto Protocol and to identify how effective selected instruments or approaches are in promoting energy efficiency, the use of renewable forms of energy and more environmentally sustainable forms of transport.

In addition, the selected cases reflect the key current and expected developments in knowledge about technological options for GHG emission mitigation in the period up to 2010-2020. In the short term, most of the opportunities to reduce emissions will come from energy efficiency gains in end-use sectors and from conversion to oil and gas. However by 2020, when it is expected that most of the power generation plants will have been replaced in Annex I EITs, the expansion of renewable energy sources will be vital in enabling further GHG emission reductions.[8]

The report's conclusion summarizes the methodological findings from the application of the evaluation criteria and the substantive findings from the case studies. The criteria were developed to study initiatives within a particular group of countries participating in the Kyoto process and facing particular opportunities and pressures. The findings from the case studies in most cases reflect particular circumstances. However, we hope that both the methodology and the findings from the case studies will also prove relevant to those in other parts of the world planning and implementing the practical measures needed to address the global challenge of climate change.

Methodology

The Convention and the Kyoto Protocol stipulate that climate change mitigation policies and measures should conform to three principles:[9] first, they should reduce GHG emissions and thus contribute to the Convention's overall goals; second, they should promote sustainable development; and third, they should correspond to national circumstances of the country taking action. The criteria and assessment factors presented in this section are designed to help promote these principles in the context of the six CEE countries examined in this report and contribute to the on-going global discussion among parties to the Convention and experts on "good practices."

The Convention and the Kyoto Protocol do not define "good" or "best" practices in policies and measures. Participants at the G8 Environmental Futures Forum 2000, discussing G8 experience in policies and measures, defined best practices as the optimal of the most progressive initiatives among countries' domestic measures to mitigate climate change.[10] The two workshops held by the UNFCCC Secretariat in 2000 and 2001 presented different approaches and experiences in "good practices" but failed to agree on organizing principles for their discussion or assessment.

It is not surprising that parties and experts cannot agree on what constitutes "good practices" in climate change mitigation policies and measures. Policies or measures that are effective in one country may not necessarily be politically acceptable or applicable in other countries. In this context, this report attempts to shift the discussion from what a good practice is to how to monitor outcomes and identify good practices by their ability to meet social, development and GHG reduction and climate change mitigation objectives.

If national policy makers are to make well informed and sound decisions, they need means to assess how effectively various policies, measures and projects achieve the objectives of the Convention and the Kyoto Protocol, and support national development goals. While national circumstances and development objectives vary widely among the parties to the Convention, decision-making in each country will benefit from information about the kinds of objectives and criteria that specific policies, measures, instruments or projects have met in other countries. Yet thus far there have been few discussions on possible criteria for assessment or exchange of information and experience among countries about the kinds of objectives various policies and measures meet or the criteria for their assessment.

WRI, the REC and NGOs from Bulgaria, the Czech Republic, Hungary, Poland, Romania and Slovenia collaborated in designing and applying criteria for assessing good practices in climate mitigation policies and measures. A full menu of six criteria and associated factors for their measurement (see Table 2) were initially designed at a workshop of the eight organizations involved, held in August 2000. Each of the national NGOs applied the criteria to one or two climate change mitigation policies, measures or projects that it selected. At a meeting convened in September 2001, government officials and businesses from CEE countries discussed and reviewed the criteria and findings.

TABLE 2

Menu of criteria and factors used in national case studies

Criteria	*Factors used for assessment*
Environmental outcomes	GHG emissions reduced/potentially reduced (where specific data had not been collected, energy savings were used as a proxy);
	Reduction of other pollutants (e.g., NO_X, SO_2, particulates).
Economic/social outcomes	Pay-back period (ratio of project costs to savings from reduced energy costs);
	Cost sharing (ratio of private-public, local-regional-state budgets);
	Cost-effectiveness of CO_2 emissions savings;
	Job creation (number of new jobs);
	Social benefits (costs reduced for consumers, disadvantaged groups or local administrations).
Technical outcomes	Use of innovative projects/technologies compared to average in country;
	Use of renewable energy sources.
Institution building potential	Development of institutional infrastructure to support good practices (e.g., new departments, positions, networks);
	Consolidation of new financing arrangements.
Project sustainability	Institutionalization;
	Financial sustainability.
Dissemination/replication potential	Information availability Number of similar projects initiated in country;
	Conditions available for replication (incentives, policies, financing).

Source: Meeting of CEE NGOs, Government and Business Representatives, WRI-REC Capacity for Climate Protection in CEE Project, September 2001.

The case studies suggest that a definition of "best" practices requires consistent analysis and comparison between different policies, measures and projects to reduce GHG emissions. Such analysis is not currently available.

The findings from the application of the criteria to the selected practices in the six countries discussed in this report identify "good" practices as those that produce positive outcomes when assessed against the criteria below.

Environmental outcomes

The factors used to assess the "environmental outcomes" criterion are reductions in GHG emissions and reductions of other pollutants, such as particulates, sulfur dioxide (SO_2) and nitrogen oxides (NO_X).

This criterion captures diverse positive environmental outcomes from reducing climate change risks (and complying with treaty obligations) to improving regional and local air quality.

Economic and social outcomes

Two different clusters of factors measure economic and social outcomes: those assessing the specific economics of the measures or projects, and those assessing the subsequent impacts on economic life. The first cluster includes such factors as project payback period and CO_2 reduction costs, which will determine whether climate change mitigation measures are cost effective. The second cluster looks at social and political issues such as job creation and reduction of costs for consumers.

Technical outcomes

Technical benefits are designed to measure whether climate change mitigation in the implementing country leads to technological innovation, either overall or in the energy sector specifically.

Additional evaluation criteria

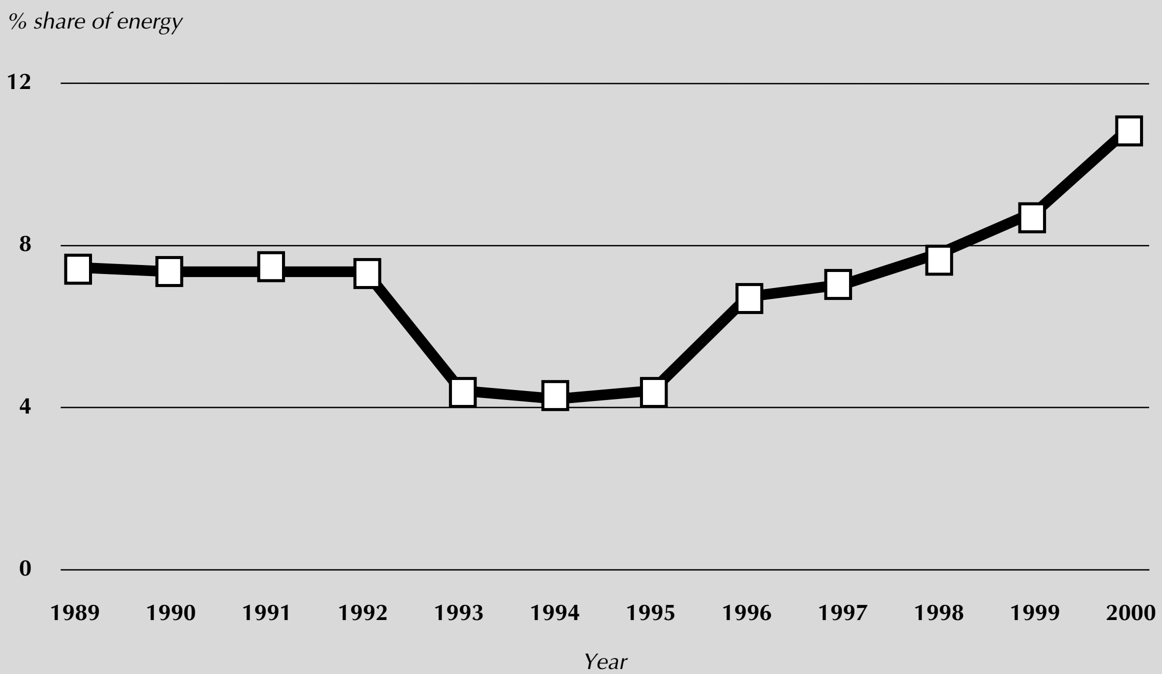
The final three criteria — institution building potential, project sustainability and replication potential — are designed to indicate whether and how well climate change mitigation measures and projects can be sustained and repeated nationally and beyond. Some assessment factors are quantifiable, such as number of staff, institutional networks for implementing similar measures and number of similar projects. Others are more difficult or even impossible to quantify, such as conditions for replication or consolidation of new financing arrangements.

The criteria are designed to ensure that policies and measures both meet the goals of the Climate Convention and support national priorities of the CEE countries. For instance, measures that produce multiple environmental benefits will support the efforts of the accession countries to meet the strict EU environmental requirements and thus reduce overall investment needs for environmental improvement. Moreover, the public in each CEE country is more likely to provide political support to GHG mitigation measures if they also improve regional and local air pollution, since these concerns are much more visible and immediate than those of global climate change.

The economic and social outcomes of climate change mitigation measures are particularly important for CEE. Most of these countries have yet to return to their 1989 or 1990 GDP levels, and their economies are still recovering as the transition has decimated the living standards for most of their populations. For instance, national communications to the UNFCCC Secretariat from three countries (the Czech Republic, Bulgaria and Poland) illustrate that significant political and social risks have delayed the anticipated phasing out of subsidies and liberalization of energy prices. A main reason for this delay is the heavy burden that energy costs have (and continue to impose) on socially disadvantaged groups in some countries.[9] Figure 1 shows how in Bulgaria energy costs, as a proportion of household expendi-

FIGURE 1

Relative share of energy costs to total household expenditures in Bulgaria



Source: EnEffect, *Bulgaria Power Sector Reform*, Sophia, 2001.

tures, have risen rapidly over the past five years. To incorporate these political and social risks, one factor measures cost reductions for consumers.

Some of the factors proposed and tested in the case studies are likely to be relevant to many countries not included in this report. For instance, job creation or cost effectiveness of CO_2 emission reductions are likely to be a concern in decision-making in most countries irrespective of other national circumstances. Other factors, however, are likely to be meaningful only for some countries. For instance, financing schemes for new technologies or municipal initiatives are still emerging in Central and Eastern Europe. Local governments rarely have access to the necessary level of capital although they frequently have a strong financial motivation to implement energy efficiency measures or other initiatives that have positive environmental impacts and reduce GHG emissions. Therefore a factor such as "new financing arrangements" is likely to be relevant only for countries where no such arrangements exist or where the existing arrangements are insufficient to support action by institutions motivated by non-environmental considerations to implement activities reducing GHG emissions.

The criteria were developed to study initiatives within a particular group of countries participating in the Kyoto process, facing particular opportunities and pressures. The findings from the case studies in most cases reflect particular circumstances. However, we hope that both the methodology and the findings from the case studies will also prove relevant to those in other parts of the world planning and implementing the practical measures needed to manage GHG emissions.

Endnotes

1 "Annex I" includes the European Union and the following countries: Australia, Austria, Belarus, Belgium, Bulgaria, Canada, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Latvia, Liechtenstein, Lithuania, Luxembourg, Monaco, Netherlands, New Zealand, Norway, Poland, Portugal, Romania, Russia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, Ukraine, United Kingdom and United States Source: <www.unfccc.int>.

2 UNFCCC, Article 4.

3 Kyoto Protocol, Annex B.

4 Kyoto Protocol, Art. 2.

5 Throughout the report the terms Central and Eastern European (CEE) countries, economies in transition (EIT) and accession or candidate countries are applied to the six countries represented here. Specifically, the term "CEE countries" refers to their geographic location, EIT indicates their current stage of development and reform, and all six countries are candidates for accession to the European Union. While the three terms are not interchangeable in most cases (there are EITs not in CEE and not all CEE or EIT countries are candidates for accession to the European Union) the three terms do apply for the six countries in this report.

6 Our definition of "good practice" is essentially similar to that of "best practice" adopted by the G8 Environmental Futures Forum 2000's report on *Domestic Best Practices Addressing Climate Change* (Environment Agency, Government of Japan, 2000). We prefer the term "good practice," however, since the present state of knowledge is too uncertain to allow a clear definition of "best practices."

7 Ministry of Waters, Forest and Environmental Protection, *The Second National Communication to the United Nations Framework Convention on Climate Change,* April 1998, Bucharest.

8 IPCC-XVII/Doc. 3e, Add. 1 (19.III.2001) "Climate Change 2001: Mitigation." Technical summary.

9 UNFCCC, Article 4; Kyoto Protocol, Article 2.

10 Global Environmental Department, Environmental Agency of Japan, *Main Conclusions of the G8 Environmental Futures Forum 2000 on Domestic Best Practices Addressing Climate Change in G8 Countries*, held in Japan in February 2000.

11 Center for Energy Efficiency, *Bulgaria Power Sector Reform*, Sofia, December 2000.

Bulgaria
Regional and Local Government Initiatives

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Introduction

The Bulgarian Center for Energy Efficiency, EnEffect, chose to focus on regional and local government initiatives in the area of climate change. This choice was based on the great potential for reducing GHG emissions that improvements in energy efficiency on the demand side offer, as well as the vital role that local governments can play in ensuring that these measures are sustainable and offer the full range of potential benefits. It was also based on the wish to promote awareness of a number of local initiatives in Bulgaria both within the country and in other countries of the region. The case studies were based on interviews and data gathered directly by EnEffect and its partners in this work.

Overall, the study consists of five sections. The first considers the potential role of local government initiatives in energy efficiency and climate change in the context of national policy, as well as the legal powers and responsibilities assigned to them. The second identifies the specific criteria for the assessment of good practices in the selected sector. The remaining three concern the following case studies: the Energy Efficiency Demonstration Zone in the city of Gabrovo, the Municipal Energy Efficiency Network, EcoEnergy and the regional energy centers in the Lovech and Haskovo regions. The case studies are evaluated according to the specific criteria selected. On the basis of this material, general conclusions are given about the "good practices" that these cases embody. At the end of the study, recommendations are given for the development of favorable conditions for the identification, implementation, dissemination and promotion of "good practices" in GHG policies and measures.

National Climate Change Action Plan — Recommended Measures for Regional/Local Initiatives

The National Action Plan on Climate Change (NAPCC) adopted by the Bulgarian government in June 2000 is the foundation for the climate change mitigation activities to be carried out in Bulgaria. The NAPCC has been developed as a set of model measures that will allow reduction of GHG emissions from industry and households without adverse impacts on the economic development or standard of living of the country. Our assessment of the case studies selected was based upon the provisions and priorities of this document. Conversely, the authors are convinced that the projects presented can support the promotion and implementation of the NAPCC.

The NAPCC recommends combined measures in two groups: sectoral measures and integrated measures at the national level. The sectoral measures include a variety of technical, organizational, managerial, investment, regulatory and financial elements. At the national level, integrated administrative, legislative, economic, educational and research measures of GHG mitigation policy are set out.

Municipalities are not addressed as a specific target group by the NAPCC. However, the activities which municipalities should undertake for climate change mitigation include both sectoral and integrated groups of measures in the fields of:

- the energy sector — reduction of losses in heat transmission and distribution networks; modernization of heat and gas supply to households;
- energy demand — energy efficiency in transportation, services and households;
- waste management;

- institution building — development, approval and application of consistent climate change municipal action plans;
- introduction of new economic mechanisms;
- education, training and public awareness; and
- energy management.

The carbon dioxide (CO_2) reduction potential of the listed measures in the residential energy sector is very high. The NAPCC envisages a potential reduction of 3.3 million tons of CO_2 per year from the overall upgrading of heat production plants in the country, 2 million tons from the reduction of heat losses and 6.8 million tons from converting household heating to gas.

Municipalities do not have much competence in the first two areas at present, but their role is expected to increase with the privatization of the district heating companies. Municipalities already participate in the gasification process as shareholders in many cities.

Fuel and energy consumption in the household sector constitutes about 20 percent of the energy consumption in the country, and households consume more than 40 percent of all electricity. The services subsector consumes 6 percent of all energy and 15 percent of all electricity. In total, the fuel savings potential in services and households is significant — about 929 million kilowatt-hours per year.

Another group of measures recommended by the NAPCC is in energy management. These measures are relevant for municipalities as big energy consumers.

Thus, municipal/regional authorities have an important part to play in implementing demand reduction measures in the urban energy sector — they can take the lead in undertaking some measures while in others they have a significant support role. However, they can only do what their competence, defined by the legal framework, allows.

Local Authority Competence over Climate Change Mitigation

Under the conditions currently prevailing in Bulgaria, municipalities have at their disposal relatively limited economic and, hence, political autonomy despite being democratically elected. Local authorities possess limited ability to apply fiscal mechanisms for policy implementation. The existing local taxes and charges are not sufficient to adapt the provisions of the national legislation to particular local conditions, nor to compensate for general inadequacies in national energy demand policy. The investment possibilities of the municipal authorities are both financially and legally restricted.

The capabilities of the local governments under current environmental legislation are also inadequate. Municipal authorities can develop and pass local environmental protection programs (under the Environmental Protection Act) and programs for emission mitigation (under the Clean Air Act), which are binding on all legal entities within the municipality. However, municipalities do not have the right to impose environmental taxes and charges.

Municipalities possess a limited range of management tools for the implementation of goal-oriented policies in the field of mitigation of climate change as well. Such policies can be based on the relatively limited competence provided to local authorities by the Energy and Energy Efficiency Act:

- to approve programs for and organize the implementation of public works with respect to electricity, heat and natural gas supply, as well as the procurement of public lighting;
- to develop and implement programs for improvement of energy efficiency and the use of renewable energy sources;
- the creation of regional and municipal energy efficiency centers.

The law does not define the sources of financing for energy efficiency programs and centers. There are no funds envisaged for them in the state budget nor in the municipal budgets so their implementation depends to a large extent on the capacity of an individual municipality to procure funding.

In these specific national circumstances it is important to promote the successful initiatives of some local governments to improve energy efficiency in municipal operations.

Evaluation Criteria

The first step in identifying good practices for climate change mitigation is to select the appropriate set of criteria for evaluation. Two types of criteria — general and specific — are relevant: general criteria define what characteristics a good practice should in principle possess; specific criteria allow particular cases to be evaluated and compared to one another.

GENERAL CRITERIA

The general criteria for identification of good practices for attainment of the the United Nations Convention on Climate Change (UNFCCC) objectives may be summarized as follows:

- the practices should contribute to meeting the country's commitments under UNFCCC;
- they should be consistent with the country's development strategies;
- they should be reproducible using reasonably accessible financial and technical resources;
- they should be based on well-known and demonstrated approaches and technical solutions that may be implemented in that country as well as in other countries, thus minimizing implementation and duplication risks; and
- they should be capable of being evaluated and compared according to objective criteria.

SPECIFIC CRITERIA

The selected range of criteria aims at evaluating the good practices in policies and measures to mitigate GHG emissions both qualitatively and quantitatively. The quantitative criteria are essential for objective recommendations for the application of a particular measure to be made. Nevertheless, in our opinion the use of only quantitative indicators is not sufficient since in order to approve a given practice as "good" (that it is worthy of emulation) it must produce significantly better results than other projects receiving comparable levels of investment. It should contain a certain element of qualitative innovation — either technical or organizational. Under the conditions prevailing in Bulgaria, for instance, good practices should strengthen institutional capacity to manage environmental protection and GHG reduction — determining whether a particular initiative achieves this must involve a qualitative judgement.

QUANTITATIVE CRITERIA

The most important characteristics of good practices addressing climate change are assessed using quantitative criteria. Three main groups of indicators are used in this study to assess the resources invested at the beginning of the respective practice and the results achieved by it:

- **Energy saved** — measured by: quantity of energy saved in megawatt hours per year and megawatt hours for the overall duration of the project.
- **Environmental benefits** — measured by: tons of CO_2 equivalent other pollutants (in particular, NO_x, SO_2, and particulates).
- **Economic benefits** — measured by:
  - — repayment period/simple payback (years)
  - — cost-effectiveness (annual savings in USD per year; cost per ton of CO_2 equivalent reduced)
  - — cost-sharing (private-public, local-state budgets participation in project funding)
  - — jobs created/preserved
  - — share of project(s) owned by the community
  - — benefits for the community
  - — benefits for important or vulnerable groups.

In principle, each of these elements can be quantified. In practice, however, quantitative information may not always be available for every point.

QUALITATIVE CRITERIA

The qualitative parameters set out here assess the elements of good practice that cannot be measured using physical or monetary units. Nevertheless, they have an impact on the quantitative characteristics of the project and affect its final result. The qualitative criteria reflect also those elements of good practice that in terms of their significance exceed the framework of the concrete project. The incorporation of a larger number of qualitative criteria may help identify the incidences when a project achieves the status of "good practice."

- Sustainability of the project. This is a complex criterion, which may be assessed through evaluation of the following distinct components:

— institutionalization;

— consistency with other national policy goals;

— financial sustainability (i.e. are sufficient financial resources available to keep the project viable over time?)

— energy saving potential (i.e. does project offer sufficient savings to justify its continuation?);

— GHG emission reduction potential (i.e. does the project offer sufficient GHG reductions to justify its continuation?);

— simplicity of implementation;

— integration (i.e. how activities and institutions are integrated with one another); and

— flexibility (i.e. capacity to adapt to changing circumstances).

- Dissemination potential. Closely connected with project sustainability and is measured by:

— availability of information;

— number of similar projects replicated; and

— creation of a favorable environment for implementation of similar projects.

Using the qualitative and quantitative criteria together to assess "good practice" enables a more precise understanding of its strengths and weaknesses. The problem is that the qualitative criteria do not allow comparison between practices. It is possible to use expert assessments, but this method requires the involvement of highly qualified evaluators. Most accessible are the assessments that are based on the availability or the lack of selected qualitative criteria.

QUANTITATIVE/QUALITATIVE CRITERIA

- **Technical Benefits.** This criterion includes elements whose assessment has both qualitative and quantitative aspects. It comprises:

— degree and extent of technological innovation;

— type and extent of renewable energy source use; and

— degree and extent of improvement in services.

Case Study 1
Energy Efficiency Demonstration Zone

OVERVIEW OF THE PROJECT

The Energy Efficiency Demonstration Zone in the City of Gabrovo project is a municipal initiative aimed at enhancing energy efficiency. Although a local project, it gives priority to meeting national goals for creating the enabling conditions for the adoption of energy efficiency measures that generate economic benefits and mitigate GHG emissions.

Gabrovo is a typical example of a medium-sized Bulgarian city, and it can serve as a demonstration for many cities in the country. It is also one of the 262 municipal centers. The building stock of the city is typical for the country in terms of methods of construction, technical indicators and ownership. The structure of final energy consumption in Gabrovo is identical to that of the country as a whole. Gabrovo is one of the 20 cities in the country where district heating systems for both the residential and the industrial sector are in operation.

The commitment and positive attitude of Gabrovo municipal authorities to energy efficiency has been of great importance for the success of the project. Gabrovo municipality is an active member of the National Association of Municipalities. It also plays a leading role in the Municipal Energy Efficiency Network. Both organizations offer good opportunities for exchange of experience and dissemination of information.

The project emerged in 1992 in the framework of the UN/ECE project Energy Efficiency 2000. In 1997 the project was approved for funding by the Global Environment Facility (GEF) through the United Nations Development Program (UNDP) and was recommended as a model. The project has a five-year period of implementation, which started in May 1998. In the three years since the project began, a considerable portion of the planned activities have been implemented or entered the process of implementation.

Energy Efficiency 2000 defines an Energy Efficiency Demonstration Zone (EEDZ) as an administrative area within which energy efficiency is promoted through the right combination of policy, management methods and technical solutions to support the implementation of investment programs for energy conservation and the reduction of GHG emissions.

The development objective of the Gabrovo Zone is to overcome barriers to better energy efficiency and reduced GHG emissions. The major barriers include:

- limited experience in incorporating energy efficiency considerations into private and public decision-making;
- little experience in developing and implementing energy efficiency programs;
- uncertainty regarding the energy and economic savings that can be expected from different energy products and programs; and
- an undeveloped infrastructure, including the institutions and individuals needed to deliver the technical, managerial, and financial services required by an energy-efficient society.

PROJECT ACTIVITIES

In order to achieve long-term impact and sustainability of results, the project is organized into two major components:

- capacity building activities; and
- demonstration projects.

The capacity building activities include municipal energy management, training and financing activities. The demonstration projects for street lighting, district heating and building retrofitting focus on areas of great importance for the governments of local municipalities.

CAPACITY BUILDING

The capacity building activities are directed not only at Gabrovo, but also support the Municipal Energy Efficiency Network (MEEN), and aim to raise awareness and promote energy efficiency among local governments on a sustainable basis. Conversely, the Network is used as a mechanism for dissemination of lessons learned in the Gabrovo Demonstration Zone. Since MEEN is presented in this report as another "good practice," only the activities directed specifically at the Gabrovo municipality will be presented here.

Incorporating energy efficiency considerations into public/municipal programs and strategies

This component is important because it creates the institutional, informational, and political basis for long-term energy efficiency activities in municipalities and establishes a system for sustainable energy management.

An Energy Efficiency Office was created within Gabrovo Municipal Administration as a mechanism for identifying energy-saving opportunities in municipal operations, developing and implementing programs for energy efficiency and influencing municipal decision-making. An information system (database) for monitoring and reporting energy consumption by types of energy sources for each facility of the municipal sector was created and maintained. A model and a pilot project for an energy efficiency program were elaborated. This is a new practice for Bulgarian municipalities and the approach adopted is an innovative one for Bulgaria.

Evidence of the importance of the capacity-building activities in the project and their correspondence to the national priorities is the fact that similar activities were recommended by the Energy and Energy Efficiency Act (1999).

Training and education

A number of seminars and workshops were conducted during the project period on different topics connected with energy efficiency. A specialized training course for municipal experts from MEEN was conducted. Training materials on municipal energy planning and management, energy audits, assessment of the energy efficiency potential and environmental benefits, planning, management and financing of energy efficiency projects were developed. The trainees developed draft municipal energy efficiency programs and business plans for priority energy efficiency projects.

Overcoming financial barriers

This subproject includes activities related to overcoming the barriers of financing local energy efficiency projects and programs. Emphasis was placed on the benefits of the demonstration energy efficiency projects in Gabrovo, especially for municipal budgets and for financing local initiatives.

Information about financing options and sources was developed and periodically updated to inform interested business and municipal leaders about options to finance energy efficiency. Gabrovo municipality applied for and received funding for the street lighting demonstration project from the National Environment Protection Fund in the form of a zero-interest loan. The District Heating Company is also applying for a loan from the Fund for the implementation of some of the activities in the district heating demonstration project. Other financing options were also used. An incentive program for consumers of heat energy was started in Gabrovo. Each consumer who bought a thermostatic valve (TRV) received a second for free, thus involving consumers in financing energy efficiency. All consumers received heat allocators, which were partly subsidized by the project and partly financed by the DH company.

An important part of this component was the study and analysis of the legal framework and the recommendations for its amendment to be submitted to central and local authorities in order to elicit support for, and encouragement of, activities which rationalize energy consumption.

DEMONSTRATION PROJECTS

Energy efficiency improvement of city street lighting system

Based on the results of a comprehensive technical and economical evaluation of the street lighting system, the following energy efficiency measures were identified for implementation:

- reducing the total number of fixtures;
- replacing existing mercury lamps with high pressure sodium ones, thus reducing total installed power from 2,315 kilowatts to 640 kilowatts;
- introducing 100 percent reading of energy consumption using two-tariff electric meters; and
- introducing net remote control and installation of electronic control system for night and semi-night duty cycle.

This demonstration subproject should result in the reduction of CO_2 emissions by 8,342 tons per year. Over the course of the sub-project life cycle, these emissions total 83,420 tons. There will also be

TABLE 1

Projected and intermediate results of the street lighting demonstration project

Results		*Unit*	*Projected*	*Intermediate results*
Annual savings		leva	572,000	140,857
Annual energy savings (electricity)		MWh/year	4,900	1,270
Duration of the project		years	10	10
Payback period		years	1.6	1.9
Investments total		leva	909,000	270,000
Cost sharing by the municipality		leva	330,000	57,000
Emission reduction:	**SO_2**	t/year	117	27
	NO_X	t/year	7	2
	CO_2	t/year	8,262	1,876
	CO	t/year	0.6	0.14
	Dust	t/year	13	3
	CH_4	kg/year	10	2
	N_2O	kg/year	257	58
	NMVOC	kg/year	11	2
	CO_2 equivalent	t/year	8,342	1,894
Cost per ton emission CO_2 eq. reduced		USD/ton CO2 eq.	11	14

TABLE 2

Projected and intermediate results of the district heating demonstration project

Results		*Unit*	*Projected*	*Intermediate results*
Annual savings		USD/year	367,400	277,000
Energy savings		heat MWh/year electricity MWh/year	24,300 748.2	8,000 0
Duration of the project		years	15	
Payback period		years	3.6	0.59
Investments total		USD	1,519,000	329,200
Cost sharing by the recipient		USD	304,000	178,800
Emission reduction:	**SO_2**	t/year	262.1	71.8
	NO_x	t/year	25.4	7.1
	CO_2	t/year	9,815.5	2,475
	CO	t/year	3.4	1.0
	dust	t/year	5.9	1.1
	CH_4	kg/year	17.5	0
	N_2O	kg/year	436.1	0
	NMVOC	kg/year	19.7	0
	CO_2 equivalent	t/year	9,951.1	2,475
Cost per ton emission CO_2 eq. reduced		USD/ton CO_2 eq.	10.2	8.9

a reduction in sulfur emissions as an indirect result of this component. The intermediate results of the project suggest that the expected results will be achieved (See Table 1).

The main problems of street lighting systems in Bulgarian municipalities were identified on the basis of the demonstration project in Gabrovo, including problems with ownership, tariffs, technologies for lighting and control, and maintenance. Ways to eliminate inefficiency and to assure financing were discussed in specific sessions and workshops.

Energy efficiency renovation of the district heating plant and heating end-use

Following the recommendations for a comprehensive technical and economical energy evaluation of the district heating facility, the distribution network, and a random representative sample of utility's end-user customers, the following basic energy efficiency measures were envisaged within this project:

- **distribution and end-use measures:** replacement of direct sub-stations with complete, modernized and automated indirect sub-stations; automation of existing indirect sub-stations; installation of heat meters in sub-stations; installation of thermostatic valves and cost allocators in residential buildings;
- **measures in heat transportation:** replacement of existing, damaged foam concrete pipes with pre-insulated pipes; replacing gland compensators with expansion joints; introduction of variable speed control of the water network circulation pump; and
- **repairs to the district heating plant.**

The selected measures correspond to the priorities set in the strategy for strengthening district-heating systems, adopted by the national government in 2000.

These measures should reduce CO_2 emissions by 9,950 tons per year, or nearly 149,250 tons over the project's duration. There will be additional benefits in reduced sulfur emissions (See Table 2).

TABLE 3

Projected and intermediate results of the building retrofit demonstration project

RESULTS	UNIT	HOSPITAL		SCHOOL		RESIDENTAL	
		Projected	*Final*	*Projected*	*Intermediate*	*Projected*	*Intermediate*
Annual savings	USD	48,500	46,690	20,680	15,880	5,890	3,726
Annual energy savings	Heat MWh/yr	2,400	2,310	564	417.5	260	166
	Electricity MWh/yr		27	27	40	30	9
Duration of the project	Years	10	10	10	10	10	10
Payback period	Years	2.2	2.2	2.8	2.7	2.5	1.7
Investments total	USD	105,000	103,060	57,913	42,846	15,000	6,169
Cost sharing by the municipality/host company	USD	10,000	10,000	14,000	14,000	0	0
Emission reduction:							
SO_2	t/year	13.16	12.65	5.6	4.3	3.2	2.2
NO_x	t/year	1.64	1.58	0.9	0.7	0.3	0.2
CO_2	t/year	746.49	717.78	326.3	253	147.3	101.0
CO	t/year	16.32	15.69	0.1	0.1	0.1	0.0
Dust	t/year	0.00	0.00	0.2	0.1	0.1	0.1
CH_4	kg/year	27.42	26.37	1.2	1.2	0.8	0.6
N_2O	kg/year	645.41	621.21	14.2	14.1	20.8	15.4
NMVOC	kg/year	25.92	24.95	6.7	5.1	0.9	0.7
CO_2 equivalent	t/year	947.15	910.91	330.7	257.4	153.7	105.8
Cost per ton emission CO_2 eq. reduced	USD/ton CO_2 eq.	11.09	11.31	17.51	16.65	9.76	5.83

Retrofitting existing buildings to reduce energy use

This element demonstrates the economic potential of retrofitting typical buildings: a hospital, a school, a multi-family residence and an industrial building. Measurements in the building envelope and the heating and electricity systems are selected after evaluation of their energy and economic efficiency within each specific demonstration building.

When compared to the baseline situation, this subproject will result in a reduction of CO_2 emissions of about 1,689 tons per year. Additional benefits will involve a reduction of sulfur emissions and improvements in comfort (see Table 3).

In addition to the initially planned building retrofits, the municipal authorities started a retrofit of the municipal administration building.

The project was developed within the training course and included total reconstruction and automation of the boiler house, installation of heat reflectors and thermostatic valves, zone control, replacement of lighting and fixtures, and the partial repair and weather-stripping of windows.

FINANCING

The financing for the demonstration projects includes limited GEF funding, commitments from the municipality, the National Environment

INDUSTRIAL BUILDING *Projected*	MUNICIPAL ADMINISTRATIVE BUILDING *Projected*
8,018	16,345
367	401
36	
15	15
2.5	3.0
20,000	48,500
10,000	30,000
0.4	1.2
0.1	0.2
115.6	170.9
2.2	2.4
0.0	0.1
2.2	2.9
4.5	18.8
0.2	0.7
117.0	176.8
11.39	8.71

Protection Fund, and the companies involved. GEF is providing USD 2.5 million, mainly for capacity-building activities. The Ministry of Environment and Water is providing funding of USD 1.015 million from the National Environment Protection Fund for the demonstration projects in street lighting and district heating energy efficiency in the form of zero-interest loans. USAID is providing parallel financing of USD 900,000.

The municipality of Gabrovo took advantage of the external support while also making its own commitments. It co-financed some of the capacity-building activities, as well as the street lighting and school building components, and made considerable in-kind contributions to the project as a whole. The District Heating Company won co-financing from State Energy and Energy Resources Agency (USD 120,000 loan from the World Bank for heat meters; USD 55,150 for heat allocators), and also gave some in-kind contribution. Finally consumers themselves have contributed USD 71,930 to pay for thermostatic valves — an important achievement of the project.

This analysis indicates that, overall, these activities promise — and are beginning to deliver — significant quantitative and qualitative benefits given the localized scale on which they are being applied. Some of these savings benefit the municipality by reducing the energy bills paid out of the municipal budget (for street lighting, and the school and municipal buildings). Some savings benefit residential consumers, particularly those from low-income households (the savings from introducing the heat accounting system and billing according to the energy consumed, the savings from installing modern substations and possibilities provided for regulating the heat consumption, and the efficiency savings in the residential building). Moreover, these benefits are being produced in a cost-effective manner. The simple payback of the projects varies from 1.6 to 3.6 years, while the cost per ton of reduced emissions of CO_2 equivalent is about USD 10 — a substantial amount for a project addressing only the demand side of energy use.

However, the value of this project is not only in the reduced emissions or economic savings directly generated by the demonstration projects.

The raising of awareness about the global climate effects of energy efficiency measures resulting from the project and its focus on capacity and institutional building activities are also of great importance. They are prerequisites for future GHG emissions reductions. However, these effects can not be measured or calculated in advance.

Case Study 2 Municipal Energy Efficiency Network, EcoEnergy

OVERVIEW

The Municipal Energy Efficiency Network — "EcoEnergy" — is an informal, non-profit, voluntary association of municipalities that aims to:

- to coordinate efforts by member municipalities to consider and improve energy efficiency as a means of addressing important national issues within energy and environmental policy;

- to reduce energy costs as a percentage of member municipalities' budgets so that the savings can be used for other municipal priorities; and
- to reduce the energy costs incurred by individual end-users within the municipalities and to increase public support for a municipal energy conservation policy.

All Bulgarian municipalities are eligible to participate in the activities of the Network, either as a member or as an observer. At present, the Network has 31 municipalities as members. The centers of these municipalities are big and medium-sized cities, of which 19 are regional centers as well. The population in the municipalities from MEEN amounts to 2.8 million people, or 35 percent of the national total.

MEEN ACTIVITIES

Network tasks are implemented by collecting and facilitating the exchange of relevant information; training and education; conferences, workshops, and business meetings; publishing a network newsletter; joint studies, programs, and projects; and institutional contacts at national and international levels.

CAPACITY BUILDING

Institution building

The institution-building activities include first the organizational setup of the Network itself. A strategy for the development of MEEN for the period up to the year 2010 and a five-year work program have been elaborated. The annual conferences of the Network are the milestones in the consolidation of the Network and the development of its activities.

The tasks of MEEN in the member-municipalities are carried out by the Municipal Energy Efficiency Offices. They are part of the municipal administration and are the agents for promoting energy efficiency and incorporating energy efficiency considerations into municipal programs and strategies. Until now 30 such offices have been established and equipped. A computer network linking the Municipal Energy Efficiency Offices and the Secretariat has been established.

Some municipalities from the network have established municipal energy agencies in partnership with other stakeholders in the municipality, such as utilities, companies and industries.

Information database

An information system about energy consumption in the MEEN member-municipalities has been created. The system covers information about actual fuel and energy consumption by sectors and groups of municipal activities. Special information database software for municipal energy management has been developed.

Municipal energy planning

The priority actions of MEEN in the period 1998-2001 aimed to create the basis for development of a municipal energy efficiency policy. A draft model for a municipal energy efficiency program was developed and discussed; planning for energy efficiency is a new activity for the municipal authorities. Draft pilot projects for municipal energy efficiency programs were developed for two municipalities (Gabrovo and Stara Zagora). Five municipal energy efficiency programs were developed during the training course for municipal experts. The programs identified the priority actions for realizing the energy efficiency potential in the municipal sector of the respective municipalities. They envisaged a 25-30 percent reduction of energy consumption in the facilities included in the programs.

Training and Education

Seminars and workshops were conducted on different energy efficiency topics of interest to municipal experts and leaders. A specialized training program on energy planning and financial management for municipalities is under way. Training materials on municipal energy planning and management, energy audits, assessment of the energy efficiency potential and environmental benefits, and planning, management and financing of energy efficiency projects were developed. All municipalities from the Network will have the possibility of sending several representatives to this training program. The approach of the training program is "learning by doing." The participants in the first training course developed draft municipal energy efficiency programs and business plans for seven priority energy efficiency projects.

Information Dissemination

The Network publishes a newsletter, EcoEnergy. Information on different energy efficiency issues is disseminated among the member-municipalities. A Network Web site was recently created.

An example of the practical results from this information dissemination is the initiative of the municipality of Rousse to implement the Energy Saving Company (ESCO) mechanism. On learning of this mechanism, the municipal energy experts started a program for energy efficient reconstruction of the heating systems of nine schools and kindergartens owned by the municipality. The Brunata company was a partner in the project which was implemented in 1999-2000. The average savings achieved amounted to 35 percent of energy consumption.

Overcoming Financial Barriers

Overcoming the financial barriers to the implementation of municipal energy efficiency projects is carried out through three major directions of Network activities:

- improvement of the regulatory framework and provision of greater fiscal autonomy for Bulgarian municipalities;
- development of innovative financing mechanisms for energy efficiency projects; and
- implementation of investment projects as practical tests of the financial mechanisms and the opportunities provided by the sources of funding.

An important part of this component was analysis of the legal framework and the recommendations for its amendment to be submitted to central and local authorities in order to support municipal energy conservation.

The use of new financing sources and mechanisms is an essential component of MEEN's activities. In a joint effort with USAID, the Development Credit Authority (DCA) mechanism has been implemented in Bulgaria. Its application will allow energy efficiency projects to receive guarantees of 50 percent of the principal on loans from the United Bulgarian Bank over the next five years. Currently, two projects for the energy efficient retrofit of municipal facilities are being implemented with the help of this mechanism in the large municipalities of Pernik and Pazardjik.

Another funding mechanism is the USAID Ecolinks program. Examples of successful projects under Ecolinks are a project to conduct an energy audit of the municipal hospital in Gorna Oriahovitsa and devise a business plan for an energy efficient retrofit of the hospital buildings, and the energy efficiency program in school buildings in Varna.

DEMONSTRATION PROJECTS

The most important demonstration projects, providing information and incentives for undertaking similar projects by others, are those undertaken in the Gabrovo EEDZ. Because demonstrations involved typical municipal facilities with the greatest energy conservation potential they are good examples.

The project in the Gabrovo hospitals was followed by similar projects in Stara Zagora, Varna and Gorna Oryahovitsa. Street lighting projects have been initiated in most of the municipalities from the Network (e.g. Gabrovo, Stara Zagora, Rousse, Sliven, Pazardjik, Pernik, Blagoevgrad).

Several energy efficiency projects have been developed or are in a process of development by Network member-municipalities. Information for the evaluation of these projects is not yet available, but a database for specific projects is under development.

Financing

The establishment and activities of MEEN during its organizational period were financed mainly by the USAID's Municipal Energy Efficiency Initiative project and GEF/UNDP's project Energy Efficiency Strategy to Mitigate GHG Emissions: Energy Efficiency Demonstration Zone in the City of Gabrovo, Republic of Bulgaria.

The municipal members of MEEN are also providing their own in-kind contribution and financing for capacity building activities. The energy efficiency offices function within the municipal administration and are financially dependent on the municipal budget. Most of the investment energy efficiency projects are initiated with financing or at least co-financing from the municipalities themselves.

MEEN's strategy has paid particular attention to planning for transition to self-financing of the activities after the year 2002.

The character of this project makes it difficult to measure its benefits. The capacity building activities are difficult to assess with objective indicators. Nor can the Network currently provide sufficient information about all the energy efficiency projects its members are conducting. However, the energy and economic savings achieved in the projects given as examples above give ground to expectations of considerable economic and environmental benefits. The energy conservation potential in municipalities, shown in the NAPCC, is also considerable. Particularly striking is MEEN's dissemination potential. New municipalities are applying for membership, while regional municipal associations have applied for membership as associated members. Their involvement will greatly increase the number of municipalities in the network. The model of MEEN and the experience acquired by the Network has informed the establishment of a Regional Network for Efficient Use of Energy Resources (RENEUER) for Southeast Europe, together with organizations from Macedonia, Albania, Romania and Croatia.

Case Study 3
Regional Energy Centers

INITIATION AND STATUS

In 1996 the Ministry of Energy and Energy Resources started two projects in the former Lovech and Haskovo regions,[2] financed by Phare for the creation of regional energy centers and promotion of energy efficiency.

PROJECT STRUCTURE AND ACTIVITIES

The projects have been implemented in two phases:

Phase One: Development of a regional energy concept and a regional energy plan.

Phase Two: Application of the regional energy concept and implementation of demonstration projects.

The regional energy centers in Lovech and Haskovo function as initiators and coordinators of energy efficiency projects. Owing to the use they make of European experience and their employment of modern and innovative technologies, the centers are able to perform a wide range of services and activities, including:

- energy audits of companies, municipal and administrative buildings;
- coordination of project implementation;
- design and execution of energy efficiency projects;
- energy management for firms and municipalities;
- measurements and diagnostics of energy systems with modern measuring equipment;
- participation in international projects;
- financing of energy efficiency projects;
- publishing and dissemination of bulletins and brochures on energy topics;
- carrying out seminars and meetings; and
- maintaining a database for partners.

The activities of the centers above all aim at providing general advice to energy end-users, helping them reduce their energy consumption and training energy experts. The centers possess a considerable amount of information about European practices and maintain contacts with similar organizations in other countries while their modern equipment allows them to perform energy audits and to assess energy conservation measures.

DEMONSTRATION PROJECTS IN LOVECH REGIONAL ENERGY CENTER

The activities of the Lovech Regional Energy Center are managed by a consortium of companies, guided by the National Technical University — Energy Policy Unit, Athens, Greece. Under the guidance of the consortium, 34 energy efficiency projects have been undertaken in Lovech Region in five main areas:

- reconstruction of boiler houses;
- reconstruction of district heating systems;
- reconstruction of lighting systems;
- new technological equipment; and
- renewable energy sources.

These projects have a wide potential application to other facilities of the same kind, such as factories and schools.

Reconstruction of Boiler Houses

Project 1: Installation of a coal- and wood-fired local boiler for space heating in the regional center for social care in Gorna Oriahovitsa

Project 2: Installation of a centralized system for metering and control of heat consumption in 13 schools and kindergartens, Veliko Tarnovo

Reconstruction of District Heating Systems

Project 1: Control system for the combustion process of a steam boiler of capacity 120 tons per hour, DHS Pleven

Project 2: Installation of a stationary gas analyzer, DHS Veliko Tarnovo

Project 3: Electronic control of the motors of the two air fans of water heating boiler, DHS Veliko Tarnovo

Project 4: Modernization of five substations in residential buildings, DHS Gabrovo

Project 5: Replacement of main pipelines with pre-insulated ones, DHS Lovech

Reconstruction of Lighting Systems

Project 1: Reconstruction of factory lighting

Project 2: Replacement of lighting units in a school in Lovech

Project 3: Replacement of existing lighting fixtures with energy efficient ones at a university

Project 4: Replacement of existing fixtures for street lighting with energy efficient ones in a village

Project 5: Reconstruction of the street lighting, Lovech.

Project 6: Replacement of the existing mercury lamps for street lighting with energy efficient ones, Pleven

Project 7: Replacement of street lamps, Apriltsi

Project 8: Replacement of mercury lamps for street lighting with high efficiency lamps, Veliko Tarnovo

Project 9: Replacement of street lighting with new energy efficient ones, Gorna Oriahovitsa

Project 10: Replacement of lighting fixtures with new energy efficient ones in hospital surgical ward

New Equipment for Industrial Enterprises

Project 1: Reconstruction of steam distribution network of industrial plant

Project 2: Refurbishment and modernization of condensation system of industrial plant

Project 3: Replacement of DC motors and motor-generator groups of knitting machines and introduction of frequency control in industrial plant

Project 4: Installation of diesel engines tuning test desk for agricultural equipment in industrial plant

Renewable Energy Sources

Project 1: Solar dryer in furniture factory

Project 2: Installation of solar collectors for hot water in a factory

Project 3: Installation of solar collectors for domestic hot water in a Sanatorium

Project 4: Installation of solar collectors for domestic hot water

Project 5: Installation of solar collectors for domestic hot water in a kindergarten

DEMONSTRATION PROJECTS IN HASKOVO REGIONAL ENERGY CENTER

The energy efficiency demonstration projects in the Haskovo region included upgrading and reconstruction of lighting and heating systems, steam installations, heat exchangers, improvement of the building insulation and weather-stripping of windows, installation of solar collectors and the introduction of new technology in industrial enterprises. The objective of the demonstration projects was to promote energy efficiency and to encourage companies from the industrial, public and communal sectors undertaking energy conservation measures.

Twenty-eight projects for energy use in different fields have been approved and implemented:

- solar installations 3
- geothermal space heating 1
- new technology 3
- lighting installations 5
- rehabilitation of heating systems 14
- miscellaneous 2

The aggregate investments in the selected projects amount to approximately EUR 800,000.

Renewable energy sources

Four projects for the utilization of renewable energy sources have been implemented. The total investment amounts to EUR 250,300, of which EUR 226,300 have been provided by the EU Phare Programme and EUR 24,000 from co-financing of the projects by the beneficiary municipalities.

Project 1: Installation of solar collectors at a hospital

Project 2: Installation of solar collectors at a hospital

Project 3: Installation of solar collectors at a hospital

Project 4: Geothermal space heating of a municipal administrative building

Reconstruction of lighting installations

Four projects for reconstruction of the lighting systems in public buildings have been implemented. The total amount of investments amounts to EUR 28,436, including EUR 25,627 funding allocated by the Phare Programme of the EU and EUR 2,809 co-financing of the projects by the beneficiary organizations. The existing lighting systems in public buildings consist predominantly of luminaires with incandescent bulbs or obsolete luminescent lamps. The illumination is several times below the lighting standards for the respective types of premises, although the electricity consumption is higher as a consequence of the large installed capacity. The rehabilitation of the lighting systems comprises replacement of the obsolete and inefficient lighting fixtures with new and energy efficient luminaires, energy saving fluorescent lamps and electronic lighting controls, coupled with reducing the installed power capacity and meeting illumination standards, leading to improved visual comfort and reduced maintenance costs.

Project 1: Reconstruction of the lighting system of a high school

Project 2: Reconstruction of the lighting system of the surgical ward of the district hospital

Project 3: Reconstruction of the lighting system at a public building

Project 4: Reconstruction of the lighting system of an office building

New equipment for industrial enterprises

Projects for improvement of the energy efficiency have been realized in three industrial enterprises. The total amount of investments was EUR 137,693. The approach applied was full replacement of the obsolete technological equipment with new highly efficient equipment.

Project 1: Replacement of condensing pots at factory

Project 2: Replacement of vacuum pumps at factory

Project 3: Replacement of heat exchangers at factory

Rehabilitation of space heating systems

The projects comprise repair and upgrading of steam boilers, introduction of automatic controls, replacement of circulation pumps, replacement of part of the steam pipelines, radiators and air-bleeding valves and insulation.

Project 1: Rehabilitation of the space heating system and boiler room of a district hospital

Project 2: Rehabilitation of the space heating system of a district hospital: replacement of the substation in the high-rise unit

Project 3: Rehabilitation of the space heating system of the district hospital: installation of a new substation in the administrative building

Project 4: Rehabilitating space heating system at school: installing automatic control for the boiler

Rehabilitation of the space heating systems of public buildings and repair/replacement of windows in public buildings

Project 1: Rehabilitation of the space heating system and repair/replacement of windows at a high school

Project 2: Rehabilitation of the space heating system and repair/replacement of windows at primary school

Project 3: Rehabilitation of a space heating system repair/replacement of windows at a kindergarten

FINANCING

The Lovech and Haskovo regions were provided with EUR 700,000 each from the Phare Programme. This sum included the cost for the development of regional energy concepts and regional energy plans. The beneficiaries added about EUR 200,000 as co-financing for the demonstration projects. A total sum of EUR 1,183,000 was spent for the implementation of investment projects in the two regions.

The project envisaged the possibility of creating regional revolving funds for energy efficiency projects at a later date. The assets for the establishment of these funds were expected to come from donations on the part of the prospective beneficiaries — municipalities and industrial enterprises. In the region of Haskovo the work on the creation of a revolving fund is in progress.

The demonstration projects also promoted public awareness about global climate change and the importance of energy efficiency measures to mitigate it. Wide access to the information about the demonstration projects was provided to the respective groups of end users: municipal authorities in the regions, managers and engineers of industrial and district heating companies. The broad range of enterprises and facilities to which the demonstration projects were applied offers wide possibilities for their replication.

General Conclusions from the Case Studies

Although municipalities are not adequately addressed in the legislation currently in force, nor are they a specific target group of the National Action Plan on Climate Change, the activities they can implement have great potential to contribute to energy efficiency improvement and reduction of GHG emissions. They stand at the intersection of national-level policies and measures and specific local-level ones.

This report finds that the projects reviewed herein — the Energy Efficiency Demonstration Zone in the city of Gabrovo, the Municipal Energy Efficiency Network EcoEnergy and the regional energy centers — can be accepted as good practices in the Bulgarian context for the mitigation of climate change.

The Energy Efficiency Demonstration Zone in the city of Gabrovo meets fully both the definition of good practice and satisfies the quantitative and qualitative indicators developed above. This project complies fully with the framework of the national policy on climate change and is a good example of successful problem solving by local authorities.

The establishment of an active Demonstration Zone should enable the replication of its projects on a national scale. This potential is emphasized by the fact that three additional municipalities have started similar projects while the 25 Demonstration Zones in other CEE countries are also drawing on the Gabrovo experience.

The case study for the Municipal Energy Efficiency Network EcoEnergy shows the considerable impact capacity-building activities for managing energy demand at the local level may have in conditions of economic and democratic transition. The information about particular energy efficiency projects was not enough to provide indicators about all the activities undertaken by the Network's members. However, sufficient information was forthcoming to make evident the potential of these projects from technical as well as from policy and organizational points of view.

The projects at the Lovech and Haskovo regional centers fully comply with the strategic goals and model set of measures outlined in the NAPCC. They focus mainly on technical demonstrations and provide evidence for the potential economic and environmental benefits of these measures, including specific innovations such as the utilization of renewable energy sources.

Our comparison of these cases suggests that the EEDZ in Gabrovo is more valuable from a qualitative point of view because more attention was given to capacity and institution building, leading to sustainable long-term policies for energy efficiency on the local level. In combination with the activities of the Municipal Energy Efficiency Network these projects have had greater influence in removing the barriers to energy efficiency in the country as a whole than the Lovech/Haskovo projects, although the latter were successful in their own terms.

Recommendations for Future Development of Good Practices

The recommendations with respect to the dissemination and promotion of good practices presented below aim to promote their replication in other municipalities. Doing so would benefit the entire country and facilitate the fulfilment of the country's commitments under the UNFCCC and implementation of the measures laid down in the National Plan of

TABLE 4

Assessment of benefits provided by the Gabrovo EEDZ according to specific criteria

Type of criterion	*Criterion*	*Measured/Assessed by*	*Information*
Quantitative	1. Energy saved	Quantity of energy saved	Annual savings from the demonstration investment projects already achieved: 28,293 MWh heat 5,760 MWh electricity Overall expected savings: 406,000 MWh heat 61,200 MWh electricity
	2. Environmental benefits	GHG emissions reduced	Annual reduction of GHG expected: 19,982 t of CO_2 eq. Overall reduction for the entire duration of the projects: 251,000 t of CO_2 equivalent. Results achieved so far: 5,643 tons of CO_2 equivalent annual reduction.
	3. Economic benefits	Reduction of other pollutants	35.5 t/year NO_x, 403 t/year SO2, 19.3 t/year dust, 25.1 t/year CO
		Repayment period	Simple payback: 1.6 for street lighting, 3.6 for district heating, 1.7-3.0 for buildings
		Cost-effectiveness	USD 1,037,000 annual savings; Cost per ton CO_2 eq. reduced: 11 USD/t for street lighting, 10 USD/t for district heating, 5.8-17.5 USD/t for buildings
		Cost sharing	The project is financed by all parties participating: GEF/UNDP, National Environment Protection Fund, USAID, municipality of Gabrovo, District Heating Company, end-users
		Jobs created	The design and implementation of the demonstration projects created jobs both for highly qualified engineers and for local subcontractors for the repair and reconstruction works and for delivery of materials and equipment. There was not enough information to give exact figures for this indicator, but positive effects were evident.
		Extent of community ownership	The whole project is owned by the community.
		Benefits for the community	Some of the savings benefit the municipality by reducing the energy bills paid by the municipal budget (in street lighting, hospital, school building, municipal building).
		Benefits for important or vulnerable groups	Some savings are of benefit to the final consumers in the residential sector, with specific benefits for low-income households.
Quantitative/ qualitative	4. Technical benefits	Share of innovative projects/technologies	The new ventilation system in the hospital was the first of this type in the country and the region (an innovative technology); the introduction of heat accounting in the district heating system was an innovative practice for the country.
		Share of projects with renewables	None
		Improved services	The project aimed to restore an adequate level of service to consumers while consuming less energy.[1] Subprojects already completed have achieved this goal.

TABLE 4

Assessment of benefits provided by the Gabrovo EEDZ according to specific criteria continued

Type of criterion	*Criterion*	*Measured/Assessed by*	*Information*
Qualitative	5. Sustainability of project	Institutionalization	Municipal Energy Efficiency Office (MEEO) created; Municipal Energy Efficiency Program (MEEP) developed.
		Consistency with other national policy goals	Establishment of MEE offices and development of MEEP recommended by the Energy and Energy Efficiency Act; the measures in the DH system correspond to the National Strategy for the Development of DH systems; all measures correspond to the recommendations of the NAPCC.
		Financial sustainability	Economic savings from the demonstration projects provide for financial sustainability of the projects.
		Energy saving potential GHG emission reduction potential	The MEEP, based on the results of the project, envisages replication of the demonstration projects in other municipal facilities, thus providing for increased energy savings and emission reductions.
		Simplicity of implementation	The implementation of the project is not complicated.
		Integration (the practices are integrated)	The issues are addressed from different angles: from the standpoint of the municipality as an energy consumer, as a regulator and as a motivator. Capacity building, financial and technical activities are integrated
		Flexibility	The project permits an update of its targets should circumstances change.
	6. Dissemination potential	Information availability	Newsletter, Web site, workshops, training courses. Information is disseminated to the municipalities-members of MEEN, to other municipalities in the country, from the region, and other CEE countries.
		# of projects replicated	25 new EEDZ in CEE; 3 new zones in Bulgaria; new projects in hospitals, school buildings, street lighting in municipalities of MEEN.
		Created favorable environment	Awareness raised among municipal authorities in the country; communicated municipal problems for increased energy efficiency to the government

TABLE 5

Assessment of benefits provided by MEEN, according to specific criteria

Type of criterion	*Criterion*	*Measured/Assessed by*	*Information*
Qualitative	1. Sustainability of project	Institutionalization	31 municipalities are members of the Network; 30 Municipal Energy Efficiency Offices created; 3 municipal energy agencies created; a model Municipal Energy Efficiency Program (MEEP) was developed.
		Consistency with other national policy goals	Establishment of MEE offices and development of MEEP recommended by the Energy and Energy Efficiency Act, 1999; all measures correspond to the recommendations of the NAPCC.
		Financial sustainability	Will be provided on the basis of energy and economic savings from the EE projects; introduction of membership fee planned. Some barriers exist that do not allow the municipality to retain the savings or reinvest them in other energy efficiency projects.
		Energy saving potential	Excellent
		GHG emission reduction potential	Excellent
		Simplicity of implementation	Implementation of the activities is not complicated.
		Integration	Capacity building, financial and technical activities are integrated
		Flexibility	The annual conferences of MEEN allow for an update of its targets should circumstances change.
	2. Dissemination potential	Information availability	Newsletter, Web site, workshops and training courses for the municipal members of MEEN, to other municipalities in the country, the region, and other CEE countries within regional projects
		# of projects replicated	MEEN was created by 23 municipalities; now it encompasses 31. New municipalities apply for membership. Regional municipal associations have applied for membership as associated members. Their involvement will increase the number of municipalities in the network to 156, which is 60% of the municipalities in the country.
		Created favorable environment	Awareness raised among municipal authorities in the country; signals to the government transferred about municipal problems for increased energy efficiency; partnerships with NGOs established.

TABLE 6

Assessment of benefits provided by the regional energy centers, according to specific criteria

Type of criterion	*Criterion*	*Measured/Assessed by*	*Information*
Quantitative	1. Energy Saved	Quantity of energy saved	Annual savings: 27,571.8 MWh energy Overall expected savings: 33,0861.6 MWh energy
	2. Environmental benefits	GHG emissions reduced	Annual reduction of GHG expected: 10,059 t of CO_2 eq. Overall reduction for the duration of the projects: 106,611t of CO_2 equivalent.
		Reduction of other pollutants	70.5 t/year NO_x, 69.9 t/year SO_2, 11.0/year particulates
	3. Economic benefits	Repayment period	Simple payback: Lovech Region — 2.7 years, Haskovo Region — 3 years
		Cost-effectiveness	EUR 411,386 annual savings; Cost per ton CO_2 eq. reduced: Lovech Region — EUR 10.95/t, Haskovo Region — EUR 11.21/t
		Cost sharing	Phare Programme — EUR 1,400,000 Lovech Region — EUR 100,000 Haskovo Region — EUR 100,000
		Jobs created	The design and implementation of the demonstration projects created jobs both for highly qualified engineers, and for local subcontractors for the repair and reconstruction works and for delivery of materials and equipment.
		Extent of community ownership	Lovech Region — 44% Haskovo Region — 84%
		Benefits for the community	Some of the savings benefit the municipality by reducing the energy bills paid by the municipal budget (in street lighting, hospital, school building, municipal building).
		Benefits for important or vulnerable groups	Some savings are of benefit to the final consumers in the residential sector, with specific preference for the low-income households.
Quantitative/ qualitative	4. Technical benefits	Share of innovative projects/technologies	Lovech Region — 11% Haskovo Region — 15%
		Share of projects with renewables	Lovech Region — 22% Haskovo Region — 15%
		Improved services	The projects were based on reaching the normative levels of services with more efficient use of energy and even with less energy consumed.
Qualitative	5. Sustainability of project	Institutionalization;	Lovech Regional Energy Center created; Haskovo Regional Energy Center created;
		Consistency with other national policy goals	The establishment of regional energy centers is recommended by the National Climate Change Action Plan
		Financial sustainability	Economic savings from the demonstration projects provide for financial sustainability of the projects.

TABLE 6

Assessment of benefits provided by the regional energy centers, according to specific criteria continued

Type of criterion	*Criterion*	*Measured/Assessed by*	*Information*
Qualitative	5. Sustainability of project	Energy saving potential GHG emission reduction potential	The regional energy centers envisage replication of the demonstration projects in other municipal and industry facilities, thus providing for increased energy savings and emission reductions.
		Simplicity of implementation	The implementation of the project is not complicated.
		Integration (the practices are integrated)	The issues are addressed from different angles: from the standpoint of the municipality as an energy consumer, as a regulator, as a motivator.
		Flexibility and dynamics	The project permits an update of its targets should circumstances change.
	6. Dissemination potential	Information availability	Newsletter, Web site, workshops and training courses for the municipal members of MEEN, to other municipalities in the country, the region, and other CEE countries
		# of projects replicated	None
		Created favorable environment	Awareness raised among municipal authorities and commercial sector; messages to the government transferred about municipal problems for increased energy efficiency

Action on Climate Change. There is a strong interest on the part of local authorities in these types of projects and this interest can help drive their promotion.

Three tasks stand out as priorities if good practices are to be effectively identified and disseminated:

FORMULATION OF NATIONAL CRITERIA FOR PROJECT EVALUATION

Good practices represent successful projects in which an innovative organizational, technological and/or technical approach has been applied. Projects where high results are achieved have the potential to act as demonstrations suitable for wider replication — to realize this potential, however, their results and methods must be adequately disseminated. This task may be carried out by either a governmental organization or an NGO. What is indispensable, therefore, is the availability of clear criteria for the evaluation of a project or action as a good practice for climate change mitigation. These criteria should have their national dimensions, yet they should also comply with international evaluation requirements. In Bulgaria, the Ministry of Environment and Water must take the lead in formulating these criteria. Doing so will contribute significantly to the implementation of the measures envisaged in the National Plan of Action on Climate Change.

CREATION AND DISSEMINATION OF A COMPREHENSIVE DATABASE ON NATIONAL CLIMATE CHANGE PROJECTS

As part of this process a national discussion should be held for the assessment of "good practices" to reduce GHG emissions. The best ways to use the experience and lessons learned should be identified. Discussions among specific stakeholders would enable information to be appropriately formulated and targeted.

A necessary precondition for implementation of good practices is the access to information about specific projects, the right to disseminate this information and the existence of a comprehensive project database to enable comparative studies. In Bulgaria no such database exists as of yet. The Ministry of Environment and Water and the State Energy Efficiency Agency, who are responsible for coordination of technical assistance in the field of environmental protection and energy efficiency, do not as yet keep a record of implemented projects, investments made and the results achieved. Monitoring and surveying of results have been performed only in the framework of individual projects. These results have not been systematized at the national level and no comparative assessments can be made.

USE OF THE MEDIA TO DISSEMINATE INFORMATION

Quite often activities for dissemination of the results are carried out in the framework of the specific demonstration project. This form of dissemination of good practices is particularly suitable for the countries with economies in transition since they do not possess adequate funds and institutions to perform this activity by themselves. Nevertheless, it is necessary to involve in this process the specialized institutions for dissemination of information — the media — a task which may often involve raising the awareness of people within the media about these issues.

Endnotes

1 In Gabrovo, as in contemporary Bulgaria generally, the rise in energy prices, the low availability of investment capital, the limitations on municipal expenditures during the transition period, and especially the effects of restrictions imposed by the Currency Board on energy consumption has led to comfort levels for energy consumers much lower than those previously considered the norm. For example: the temperature in the school building measured during the audit was 15 C; at the start of the project street lighting in Gabrovo was switched off for much of the night, and later completely, for eight months.

2 Prior to the latest administrative division of 1999, Bulgaria was divided into nine regions.

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Czech Republic
Greenhouse Gas Emissions in the Transport Sector

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Introduction[1]

The aim of this chapter is to identify the possibilities for reducing the emissions of carbon dioxide produced by the transport sector in the Czech Republic. The sector currently accounts for 8.27 percent of total national CO_2 emissions.[2] The two case studies presented are of good practices based on the measures that were outlined in the chapter, "Provisions Leading to Emission Reduction," in the *Second Communication of the Czech Republic to the United Nations Framework Convention on Climate Change*.

Specifically, this report reviews a few of those measures, including: the development of combined transport and the production and utilization of biodiesel fuel. Our criteria for assessment concentrate on quantitative environmental benefits, especially energy saved, CO_2 emissions reductions and reductions of other pollutants. Nevertheless, economic and social dimensions of the measures (namely project costs and employment benefits) are also considered.

After presenting these two case studies of good practices, we discuss briefly the findings of an analysis of other emission reduction provisions contained within the *Second Communication*. They include optimization of traffic on certain major roads and modernization of bypasses, supporting the development of urban public transport, and internalization of the external costs of transport.

To understand the implications of the policies and measures discussed below, it is necessary to review briefly the present situation of the Czech transport sector. By comparison to most other CEE countries, the Czech Republic exited socialism with a dense road and rail network. As in other "economies in transition" (EITs), the modal share of private automobile transportation and road freight was small compared to the countries of Western Europe. Since 1989, however, transportation patterns have tended to converge with those typical of the West. For instance, the share of total freight transport by road almost tripled between 1990 and 1997, reaching approximately 60 percent by 1997, whereas over the same period freight transport by railway shrunk to almost one half of its original share. A similar shift took place in passenger transport. Between 1990 and 1998, the total demand for public transport in the Czech Republic fell by 50 percent, while the number of passenger cars grew by 50 percent. As a result of these trends, CO_2 emissions from the entire transport sector (i.e., freight and passenger) rose by 20 percent from 1994 to 1999.[3]

Since 2000, the State Infrastructure Fund (SFDI) has financed most transport infrastructure development. This fund is relatively independent from the state budget. For 2001, the fund has a budget of over CZK 30 billion, (roughly USD 815 million.)[4] Some of the larger infrastructure projects which the fund cannot finance due to its statute continue to be financed by the state budget (e.g., underground construction in Prague). State-guaranteed credits from the European Investment Bank and certain commercial banks are an important source of financing. European Union funds and programs are convenient supplementary sources. Examples are the Poland and Hungary Assistance for Restructuring of their Economies (Phare) and the Instrument for Structural Policies for Pre-accession (ISPA).

The operational loss of public transport operators is covered by the state budget, while repairs and construction of small roads are funded or co-funded by municipal budgets. There is no aggregate data available on the total amount of finance flowing into the transport sector. However, expenditures on infrastructure investments are known, and show a clear

TABLE 1

RoLa energy conservation (in MJ)

Year	*Energy conserved*
1994*	475.95
1995	9,949.91
1996	14,208.86
1997	7,620.36
1998	19,007.59
1999	18,885.35
2000	19,007.00

* starting year, with minimal usage

Source: *General Management of Czech Railways,* 2001.

preference for road development over that of rail: in 2001, road infrastructure investment surpassed that in railways by more than CZK 7 billion.[5]

Given this, it appears that barring a major shift in national policies and priorities, the Czech Republic is doomed to repeat the mistakes of Western Europe and North America by allowing private road transport to develop at the expense of public and non-road transport, with all the environmental and human costs such a direction entails. The aim of this report is to examine the alternatives to such a policy.

This report is a condensed version of a longer report by the same authors, which contains more extended discussion of the policies presented in the *Second Communication*, along with more detailed data and calculations. The full report is available from the Centre for Transport and Energy.

Combined Transport

INTRODUCTION

Combined transport is defined as transportation of freight using two or more modes of transport. In the Czech Republic, the most common variant is the combination of road and railway transport. Present conditions do not allow for road-and-water and rail-and-water combined transport to reach a significant share of the total.

The road and rail combined transport systems used in the Czech Republic are: ISO containers, the "RoLa system" (Rollende Landstrasse, Rolling road), and piggyback transport with swap bodies. Road-railer bimodal systems, piggyback transport with semi-trailers, and direct transshipping of containers are not yet used in the Czech Republic.

The container transport system was brought into operation during the 1970s and was used for both transport within the then Czechoslovakia and for trade with the former Soviet Union. Most transport was in 1C-size ISO containers. After 1989, the movement of containers shifted. Transport to and from European harbors now plays a significant role.

The RoLa system — the transport of road trucks on low-floor railway carriages — was introduced in 1994 on the Lovosice-Decin-Dresden (Germany)

TABLE 2

RoLa — Air emissions reduction (tons)

	Dust particles	*SO_2**	*NO_X*	*CO*	*TOTAL*
2000	5.335	-44.145	135.239	82.480	178.909
1999	5.697	-46.111	143.835	87.589	191.009
1998	5.724	-46.298	144.516	87.998	191.940
1997	4.400	-44.153	115.852	71.667	147.766
1996	5.231	-46.176	134.206	82.228	175.490
1995	4.624	-44.014	120.414	74.190	155.214
1994	0.909	-11.626	25.321	15.979	30.582

* electric railway traction plots the average emissions for a unit of electricity produced.

Source: *General Management of Czech Railways,* 2001.

line and still operates. From 1993 to 1998 another line, which the Austrian government had subsidized, was operated between Ceske Budejovice-Linz-Villach (Austria). Transport within the Czech Republic was operated by the Czech Railways Company and Bohemiakombi[6] on both lines.

IMPACT ON CO_2 EMISSIONS

In this section, we look at how significant a role combined transport can play in reducing greenhouse gas (GHG) emissions. First, we illustrate how two already functioning systems perform, and then we calculate a projection for an "optimum-use" scenario.

The following is a review of the existing conservation measures, which in turn is followed by calculations of potential further emissions savings.

THE ROLA SYSTEM

The two RoLa systems in the Czech Republic have already led to a significant decrease in total energy consumption and CO_2 emissions. The average annual energy conservation and emissions reduction potential for 1994-2000 of the Lovosice-Decin-Schona route (still in operation) and the Ceske Budejovice-Horni Dvoriste-Summerau route (cancelled) are presented.

According to the general management of Czech Railways Co., the RoLa system conserved 7,620 megajoules (MJ) of energy in 1997 and 19,007 MJ in 2000. Also, the RoLa system has led to a reduction of total air emissions of dust, sulfur dioxide (SO_2), nitrogen oxides (NO_x) and carbon monoxide (CO) by 148 to 192 tons each year (see Tables 1 and 2).

TABLE 3

Container system — emissions reduction (tons) and energy conservation in gigajoules (GJ): 1999

CO_2 reduction	61,000
CO reduction	860
NO_X reduction	1,240
C_XH_Y reduction	370
Energy conserved	760,000

THE CONTAINER SYSTEM

The conservation of energy and reduction in the four most significant types of emissions will be calculated for the container transport system for 1999. The calculated values are estimates, because exact input data, both quantitative and qualitative, are unavailable.

The amount of transport by railway instead of road was the main calculation criterion. The performance of container transport was calculated and the energy consumption and emissions of road freight transport and combined container transport were compared. The result suggests that the combined container transport conserves large amounts of energy and significantly reduces emissions. The results are summarized in Table 3.

PROJECTED IMPACT OF OPTIMUM UTILIZATION OF COMBINED TRANSPORT

This section quantifies the benefits of combined transport for a hypothetical case, which incorporates the "optimum" use of this transportation mode. This optimum presents a case in which combined transport accounted for roughly 25 percent of the total freight transport in the country. If international freight trucks are considered, a significantly larger proportion could be achieved.[7]

Since the number of trucks that could be transported on the RoLa system cannot be estimated objectively, it is impossible to make a reliable estimate of energy conservation and emissions reduction for this mode of combined transport. Therefore, our calculation will confine itself to the container transport.

Again, the calculated values are approximate since exact input data, both quantitative and qualitative, are unavailable. The amount of freight transported on railways instead of road is again the focal calculation criterion. Let us again assume the average loads of 1,100 tons for a train and 30 tons for a truck.

Since the combined transport could constitute approximately 25 percent of total transport, and since the total freight transport is 60,000 million ton km[8], it would carry 15,000 million ton km. Therefore, container transport, being 33 percent of the total combined transport, would carry 5,000 million ton km (per year).

Based on the average energy consumption of road and rail freight transport, the calculation results in the following data:

TABLE 4

Average annual energy conservation (GJ) and emissions reduction (tons) in the optimum-usage scenario

CO_2 reduction	1,100,000
CO reduction	15,700
NO_X reduction	22,500
C_XH_Y reduction	7,000
Energy conserved	14,000,000

- The emissions for railway container transport would be 300,000 tons of CO_2, 300 tons of CO, 1,500 tons of NO_x and 500 tons of hydrocarbons (C_xH_y). The railway container transport would consume 2,000 terajoules (TJ) of energy.
- Road truck transport, on the other hand, would emit 1,400,000 tons of CO_2, 16,000 tons of CO, 24,000 tons of NO_x and 7,500 tons of C_xH_y, consuming 16,000 TJ of energy, for the same amount of freight.
- Therefore, in the best scenario, the railway container transport saves 1,100,000 tons of CO_2, 15,700 tons of CO, 22,500 tons of NO_x, 7,000 tons of C_xH_y and 14,000 TJ of energy.

ECONOMIC BENEFITS

In the absence of harmonized transport prices (i.e., internationalization of external costs — see page 40), it is possible to identify the likely economic benefits but not to quantify them.

The creation of a combined transport system can bring the following economic benefits:

- production and development of railway carriages for the combined transport;
- construction of transshipment terminals;
- production and development of transshipment terminal equipment (e.g., special cranes and container transshipment equipment);
- employment growth in the industries related to combined transport; and
- the net benefit to the state budget created by the offsetting financial subsidies against the external costs saved (which can be used to eliminate the negative economic consequences).

On the other hand, it can have the following negative economic consequences:

- a drop in production and sales of freight vehicles;
- a drop in need for new roads and motorways;
- a drop in fuel production and sales; and
- a decrease in the number of jobs in the above mentioned areas.

STATE SUPPORT OF COMBINED TRANSPORT

The 1998 Transport Policy of the Czech Republic states that combined transport is not directly addressed in legislation. Therefore changes in legislation need to take place based on standards of the European Union. It mentions the need to support development of the vehicle fleet and special equipment for combined transport and to monitor the optimal utilization of transshipment terminals and logistic centers. A government report[9] expresses similar concerns.

FINANCIAL INSTRUMENTS

The state financial instruments for the support of combined transport are:

- subsidies for the purchase of low-floor container carriages for the Czech Railways Co.;
- partial support of enterprises for establishing new combined transport systems and vehicles, such as swap bodies;
- support of modernization of transshipment mechanisms and reconstruction of logistic terminals;
- support to purchase new technology, especially for manipulation with swap bodies; and
- operational subsidies for the Lovosice-Decin-Schona-(Dresden) RoLa line.

Czech Railways Co. has been receiving steadily increasing subsidies for the purchase of container carriages since 1996. Since 1998 purchases by private

TABLE 5

Investment subsidy overview 1996-1999 (in million CZK)

	1996	*1997*	*1998*	*1999*	*2000**
Czech Railways	58	115	100	305	305
Private entities	––	––	19	36	30
Governmental	––	––	––	––	5

*proposed

Source: Systemic Support to Combined Transport Development until 2000 and 2005. Czech Ministry of Transport, 1998.

TABLE 6

Investment and operation subsidy for the Lovosice-Schona RoLa line, received and proposed. (Czech share only in million CZK)

	SUBSIDY RECEIVED			SUBSIDY PROPOSED			
	1998	*1999*	*2000*	*2002*	*2003*	*2004*	*2005*
Investment	88	85	102	450	530	610	700
Operation				190	205	220	235

Source: Systemic Support to Combined Transport Development until 2000 and 2005. Czech Ministry of Transport, 1998.

enterprises have also been subsidized. The proposal for 2000 foresees the same level of subsidy. A detailed overview of the subsidies follows.

INVESTMENT SUBSIDIES

Since 1996, Czech Railways Co. has been receiving investment subsidies for the purchase of container carriages. In 1998, the Ministry of Transport began subsidizing private businesses for the purchase of transshipment mechanisms, swap bodies, road container carriages, etc. The proposal for 2000 included a subsidy of CZK 5 million for governmental installations in the transshipment terminals. Investment support for new terminals and the reconstruction of the existing terminals has not taken place due to their sufficient capacity.

The investment subsidies for the Lovosivice-Schona RoLa line (see Table 6) are earmarked for the construction of new transshipment terminals and reconstruction of the existing facilities.

The only existing RoLa line between Lovosice and Schona has been receiving an operation subsidy, with the Czech share constituting between CZK 85 and 102 million.[10] There are proposals to raise the subsidy substantially (to CZK 235 million in 2005), but the government plans to cancel this subsidy in 2005 at the latest, when the D8 motorway across the border is opened.

LEGISLATION

Besides several amendments to existing laws (Trade Act, Enterprise Act, etc.), a new Integrated and Intermodal Transport Bill[11] was proposed in compliance with international agreements and conventions that bind the Czech Republic (e.g., The European Agreement on Important International Combined Transport Lines and Related Installations — AGTC). Unfortunately, this document has not yet left the Ministry of Transport, whose individual departments disagree on the need for such a law.

BARRIERS TO THE DEVELOPMENT OF COMBINED TRANSPORT

The principal factor limiting major expansion of combined transport is that transport prices are not harmonized. This then creates other barriers. These secondary barriers (not taking into account price factors) include inflexibility among railway haulers, little customer knowledge of the combined transport system, and the relative difficulty of route planning in a situation where a surplus exists of truck haulers, who offer convenient door-to-door service.

In present conditions, direct road transport has a competitive advantage (i.e., lower costs) over combined transport because the railway tariff is higher for combined transport than for regular freight. Another factor is the cost of road transport to and from the transshipment terminals as well as loading and off-loading (a costly affair — each container costs CZK 1,000). The operation costs of the terminal and the costs of the operator affect the competitiveness of combined transport vis-à-vis direct road transport.

The efforts of the Czech state to subsidize certain combined transport projects are only a complicated attempt at remedying the current irrational price regime. The attitude of the Czech government is demonstrated by their unwillingness to significantly support the RoLa system. This position is expressed, among others places, in the Governmental Proposal for Transport Networks Development to 2010. Furthermore, enterprises are unlikely to start any combined transport projects demanding long-term investment now that the governmental support may end at any time.

CONCLUSION

Combined transport represents a potentially significant way to reduce greenhouse gas emissions. However, the current tariffs do not support any significant expansion of combined transport and are not sufficient to compensate for the disadvantages it suffers from in comparison to road truck transport.

Biodiesel

INTRODUCTION

The objective of this section is to evaluate the possible benefit of a biodiesel fuel production support program as defined in the joint material on the reduction of greenhouse gas emissions of the Czech Ministries of Agriculture and Environment from June 22, 2000.[12] Furthermore, the study serves other functions such as evaluating other environmental benefits, considering the social and economic context, estimating the likely limitations to the use of biodiesel as well as summing up the principal obstacles and risks that impede full utilization and realization of potential benefits.

THE PRESENT SITUATION

In the Czech Republic, the term biodiesel is used for a mixture of diesel oil and “fatty acid rape oil methylester” (FARME) in which the share of FARME biofuel exceeds 30 percent of weight. The rest of the fuel consists of crude oil products chosen to maintain the 90 percent biodegradability of the final product within 21 days. This mixed fuel has certain technical advantages against pure FARME. First, the fuel does not dilute the engine lubricant oil, which thus need not be changed so often. Second, the mixed fuel does not cause problems when starting the engine at low temperatures and is comparatively less damaging to rubber pipes and paint.

The Czech support program for the production of FARME and mixed fuel, the Oleoprogram, was initiated in 1992. Its aim was primarily to support the utilization of agricultural land for non-food production and the implementation of new technologies for renewable energy generation. Lately, policy makers have recognized that this program may help solve environmental problems related to transport.

The support provided by this program so far can be divided into the following three areas:

- support for the construction of FARME and mixed fuel production facilities through loans;
- indirect support in the form of zero excise duty on the FARME produced and partial return of the excise duty to the end users of the mixed fuel (according to the content share of FARME); and
- direct support for the production of FARME and mixed fuel (see below).

There is no direct subsidy in the Czech Republic for setting aside from agricultural use similar to that used by farmers in the European Union growing rape seed for energy and fuel purposes.

On April 1, 2000, the excise duty relief for mixed fuel was cancelled, although FARME is still free from the excise duty. At the same time, direct support to the producers of FARME and mixed fuel was increased. It is expected that another form of support will be introduced in the future. This will include the purchase of rapeseed from Czech farmers and its subsequent sale to the producers of biofuels in order to maintain the price of biofuel at 90 percent of conventional diesel.[13] The present FARME production capacity is roughly 60,000 tons per year.

IMPACT ON CO_2 EMISSIONS

For the sake of simplicity, this chapter will discuss figures for FARME. The total benefit of the use of mixed fuel in the Czech Republic will be deduced from the total production of FARME as a component of the mixed fuel.

ENERGY BALANCE

The calculation of input energy for the production of FARME is influenced by a variety of factors. It depends on expected yields, energy consumption during the production of the applied fertilizers, pesticides, as well as on farming methods, production technologies, etc. Another condition influencing the total energy balance is the fact that by-products of the processing of rape (such as grouts, glycerine or straw) are also used in energy production.

All sources state a very positive energy balance for FARME (i.e., the outputs outweigh the inputs). Table 7 summarizes this balance.

GREENHOUSE GAS BALANCE

The balance of greenhouse gases is even more difficult to quantify from a methodological point of view. It cannot be defined on the sole basis of the energy balance, since other greenhouse gases also influence it. These gases, namely methane (CH_4) and nitrous oxide (N_2O), are produced in the course of the production and application of artificial fertilizers, for instance during the processing of rapeseed.

The differences between the individual sources are significant. Therefore the quantification of the likely benefit of the Oleoprogram for greenhouse gas emissions reduction is likely to be very inaccurate. The following calculation is only a rough estimate. The real reduction of emissions will probably be higher — up to three times, according to some sources.[14]

Considering that the CO_2 equivalent emissions produced during the extraction, production, transportation and burning of conventional diesel oil is 3.4 kilograms (kg) per 1 kg of oil, and considering the balance calculated by the German Institute for Energy and Environment Conservation (IFEU), the reduction of greenhouse gas emissions for 1 kg of FARME is approximately 1.2 kg of CO_2. If the Oleoprogram assumes an increase in FARME production by about 40,000 tons per year (from 1999 levels), there would be an annual reduction of CO_2 equivalent by some 48,000 tons.

IMPACT ON EMISSIONS OF OTHER POLLUTANTS

The use of mixed fuel also eliminates SO_2 emissions. FARME contains no sulfuric compounds at all and emits considerably less carbon monoxide and hydrocarbons than conventional diesel oil. FARME emits 0.77 grams of CO per kilowatt-hour and 0.19 grams of hydrocarbons per kilowatt-hour, whereas conventional diesel oil emits 0.92 grams and 0.23 grams per kilowatt-hour respectively. On the other hand, it emits slightly more nitrogen oxides (approximately 3-5%).[15] FARME offers environmental benefits beyond air pollution such as 98 percent biodegradability within 21 days and no health risk when it comes in contact with skin.[16]

ECONOMIC AND SOCIAL CONTEXT

Support for production

Between 1992 and 1995, the Czech Ministry of Agriculture granted loans for the construction of FARME and mixed fuel production facilities. The loans, totalling CZK 721.5 million, were divided among 16 enterprises with total production capacity of approximately 60,000 tons of FARME a year.

Before April 1, 2000, mixed fuel production was supported indirectly by means of zero excise duty on produced FARME and the return of part of the excise duty to final consumers of the mixed fuel (depending on the percentage of FARME). Furthermore, in 1999 and the first quarter of 2000, direct support was granted of CZK 3.0 per kg of produced FARME.

TABLE 7

Energy balance of FARME production

Source	*Balance (output : input)*	*Output includes by-products*
European Petroleum Industry Association (EUROPIE)	1.49:1 1.9:1	No Grouts
Union fur Forderung von Vel- und Proteinflanzen e.v., Germany (UFOP)	3:1	No
Institut fur Energie und Umweltforschung, Germany (IFEU)	1.47:1 3.42:1	No Grouts, glycerine, straw

Sources: Navrh reseni Oleoprogramu pro obdobi roku 2001 a dalsi roky (c.j. 1987/300/2100/320/00). MZP CR, Prague 2000 (approved by the Government in the second half of 2000).

TABLE 8

GHG balance of conventional diesel to FARME

Source	*Balance (conventional diesel : FARME)*	*Output includes by-products*
EUROPIE	1.14:1	No
UFOP	3:1-4.4:1	No
IFEU	1.54:1	No

Source: Navrh reseni Oleoprogramu pro obdobi roku 2001 a dalsi roky (c.j. 1987/300/2100/320/00). MZP CR, Praha 2000 (approved by the government in the second half of 2000).

Since April 1, 2000, the mixed fuel has been subject to excise duty identical to that of conventional diesel (i.e., CZK 8.15 per liter), whereas the zero duty on pure FARME has been preserved.

Therefore, a new form of direct support was introduced, amounting to up to CZK 13,000 per ton to the producers of FARME, and up to CZK 16,000 per ton of processed FARME to the producers of the mixed fuel.[17]

The form and financial demand of the Oleoprogram for 2001 and future years

In order to simplify the form of support and to harmonize it with common practice in EU countries, a change in the system of financial support for the production of biofuel has been proposed by the Ministry of Agriculture.

The aim of the support is to keep the price of mixed fuel at 90 percent of the price of the conventional diesel oil. The reason is that mixed fuel has a slightly lower efficiency than traditional diesel (5-7% lower).

The support is based on the principle of intervention purchase of rapeseed from Czech producers and its subsequent sale to FARME producers at a calculated price, which is significantly lower than the purchase price. Since the price is calculated so that the mixed fuel is 90 percent of the price of conventional diesel oil, it is dependent on the price of crude oil. Should the price of crude oil drop so much that a zero price for rapeseed would be needed to maintain the necessary final price of mixed fuel, an auxiliary support system is proposed. This eventuality, however, is unlikely since the price of conventional diesel oil would have to drop below CZK 17.50 per liter (i.e., approx. EUR 0.5 per liter).[18]

Intervention purchases will be managed by a state-appointed organization. The existing State Market Regulation Fund and the State Agriculture Intervention Fund now being established are both considered appropriate for this function. The state budget would cover the losses for this regulatory body. The total financial demand of the

Oleoprogram (in 2000 prices and costs) is estimated to be between CZK 0.6 and 1.6 billion, or between EUR 17 and 46 million.

Employment

The influence of the use of biofuels on employment is definitely positive. The growing of rape and producing of rapeseed oil creates new job opportunities and helps to preserve existing jobs, especially in agricultural sector. Moreover, it concerns not only producers and distributors, but also farmers, for whom rapeseed is a significant complementary crop. However, any estimate of the number of employees dependent on rapeseed farming and mixed fuel production is bound to be approximate. From the size of the crop area, the production (150,000 tons of rapeseed for the production of FARME, 22,282 tons of produced FARME in 1999) and the number of fuel stations that sell mixed fuel (274), it can be estimated that the production of rapeseed and the production and distribution of mixed fuel employs, directly or indirectly, about 2,000-5,000 people. Jobs in rural areas are preserved, which helps slow down the exodus to cities.

Limitations and barriers

The production of biofuel is limited by the size of crop areas available for growing rapeseed while maintaining crop procedures and agricultural diversity. It is estimated that the production of FARME can utilize a maximum of about 400,000 tons of rape seed every year, which is about three times as much as current use.

The present production capacity of FARME in the Czech Republic is about 65,000 tons a year. This will be fully used in 2000-2001 according to the Ministry of Agriculture. A further increase in the production capacity will be dependent on economic conditions. The present subsidy programs do not include significant support for it.

The quality of the biofuel does not present any problem at the moment, as the Czech standard "CSN 656507" complies (except in phosphorus content) with the German standard "DIN E 51606" and guarantees high quality. The use of mixed fuel eliminates certain technical problems caused by pure FARME and the slight uncertainties caused by the fact that it is a new type of fuel are compensated by the lower price.

CONCLUSIONS

The use of mixed fuel as an alternative fuel for combustion engines is undoubtedly one of the measures capable of reducing greenhouse gas emissions in the Czech Republic. Production capacity, possibilities of financial support from the state budget, and the amount of production of rapeseed as the basic raw material determine the present volume of production, which is 60,000 tons of FARME a year. This represents a reduction in CO_2 equivalent emissions of roughly 100,000 tons. Considering the financial demand of the biofuel production support program, the costs of reducing CO_2 emissions are quite high (between CZK 6,000 and 12,000 per ton). However, the reduction of greenhouse emissions constitutes only a minor part of the benefit of the use of mixed fuel. Other benefits include a reduction of emissions of sulfuric oxides, solid pollutants, and hydrocarbons. Furthermore, the social benefits must be taken into account, such as the fact that growing energy crops represents one of the principal substitution programs for Czech agriculture, which is currently experiencing a deep crisis.

It is evident that the use of mixed fuel is one measure that can reduce greenhouse gas emissions. Nevertheless, it is definitely far less significant than shifts in the usage of various modes of transport and the growth rate of individual automobile transport.

Other Provisions of the *Second Communication*

INTRODUCTION

In this section we focus on three other "Provisions Leading to Emission Reduction" that are discussed in the *Second Communication*. These are:

- optimization of traffic on certain major roads and modernization of bypasses;
- supporting the development of urban public transport; and
- internalization of the external costs of transport.

A detailed analysis of the CO_2 emission impact potentials of these three provisions was made and the following conclusions were drawn.

OPTIMIZATION AND CONSTRUCTION OF ROADS

We calculated changes in energy consumption and CO_2 emissions by road category and transport mode. The overall result of the calculation is that the total energy consumption by road transport will drop by 21 percent by 2010. All of the road categories show a drop in energy use, except motorways, whose energy use will actually increase by 16 percent. Further, we have evaluated the difference in energy consumption and CO_2 emissions between a "do-nothing" scenario and the government road-building scenario, ignoring all other influences on traffic volume. This comparison shows a difference of 9 percent in favor of the do-nothing option if the entire road network is looked at. Looking at motorways only, the difference is 46 percent.

In order to minimize the increase in energy consumption and CO_2 emissions, it is necessary not to increase the total length of the international, national, regional, local and major municipal roads. From a climate protection point of view, the only allowance that can be made is for bypasses that will: increase the flow of traffic without increasing its speed above approximately 90 kilometers per hour and shorten route lengths significantly. This presumes that the original roads that have been substituted will be closed to trunk long-distance through-traffic and will only serve local traffic. City ring roads must be built with the least possible number of lanes and on condition that through-traffic reduction measures will be undertaken inside the ring to balance the increase in road capacity on the ring. Such measures are also desirable along the outer edge of the ring.

SUPPORTING THE DEVELOPMENT OF PUBLIC TRANSPORT

Since the 1990s motorization has represented the fastest growing sector in the Czech economy. Along with this motorization, the country has been experiencing a decline in public transport. During the past five years, the modal share of public transport has decreased along with the total number of public transport vehicles used. Public transport covers less ground and its infrastructure is increasingly in disrepair; without remedial measures these trends are likely to persist in the immediate future.

Passenger transport has been almost entirely privatized on road, air and inland waterways. The state-owned Czech Railway Company is being transformed, as yet without success. A partial privatization of services on regional railways has taken place. The infrastructure is still owned by the state, but the trains are run by private companies. Since 1989, fares have risen many times over and significant commuter discounts were cancelled both in bus and railway transport. Furthermore, budgetary subsidies have been declining, especially in bus transport. Fare regulation was ended in January 2001 (railways were the last mode of transportation in which fares remained regulated).

We compared the environmental impacts of three scenarios of the Czech public transport system, working with 2010 and 2025 as time horizons and covering all important groups of emissions as well as energy consumption. The results of the individual scenarios indicate clearly that it is not enough to develop public transport. Without a concurrent decrease in individual transport, the development of public transport itself leads to an increase in energy consumption and CO_2 emissions. The emissions related to the distance travelled and to a single passenger are, however, significantly lower for public transportation than for forms of individual transport.

Therefore, only if measures are taken to reduce the volume of individual transport, and part of its passenger share is shifted towards public transport, will the total amount of energy consumed and CO_2 emitted decrease. Further public transportation development is desirable from both the social and environmental points of view.

INTERNALIZATION OF EXTERNAL COSTS

Creating a system for full payment of the external costs in transport in the Czech Republic depends on the future developments within the European Union in this field. The future of EU internalization policy is not clear. Although the *White Paper on Infrastructure Charging* for internalizing external costs provides a time line, adherence to its provisions and dates are uncertain. According to the European Commission, there must be a gradual and phased harmonization of the charging principles applied in all the main forms of commercial transport. There is no intention to penalize any one mode of transport, since the Commission favors maximum flexibility in the rates that the user will pay within each mode, depending on the circumstances of the transport operation.

In the Czech Republic, technical obstacles can be easily overcome. However, other obstacles will be difficult to deal with, such as the largely technophile thinking of decision makers and strong lobbying by the automobile industry. There is also a need to further educate the public, since people too often tend to believe road construction is the best remedy to transportation problems. People perceive the automobile as a status symbol and have economic fears (particularly about rising unemployment as a result of internalization). Last but not least of these difficulties is the strong lobbying by the automobile industry.

The internalization of external costs will certainly lead to a reduction of vehicle emissions. Higher fuel prices will encourage customers to buy more fuel-efficient, and thus more cost-efficient, vehicles. At the same time, long-term production conditions will be secured for manufacturers. Internalization will also lead to the use of more socially and environmentally acceptable modes of transport, as they will be cheaper than other modes, and to a decreased demand for transport, as people will be likely to reduce the number of trips by such means as car pooling, multiple errands, telecommuting, etc. The extent to which this will happen will depend on the level transport pricing reaches and on other factors, such as the accessibility of alternatives.

The European Conference of Ministers of Transport estimates the financial loss caused by CO_2 emissions to amount to 1-2 percent of gross domestic product (GDP). In the Czech Republic, transport represents an 8.27 percent share of the total CO_2 emissions, yielding a financial loss of CZK 2.728 billion for 1997. Since the amount of CO_2 emissions is in direct proportion to the amount of fuel consumed, it is easy to identify an appropriate level for carbon taxation.

According to the internalization model by the European Federation for Transport and Environment, the fuel tax should rise two to four times within 10 years in different countries, according to the difference in their emissions. It does not mean a large increase in fuel prices, unless crude oil becomes much more expensive. If the fuel tax increases by approximately 65 percent, the demand for fuel will decrease by some 33 percent (assuming price elasticity of -0.8). With an income elasticity of 1.1 and annual income increase of 2 percent, the demand for fuel will decrease by 17 percent. Since diesel oil is currently subject to less taxation than gasoline, the implementation of this model will cause a steeper increase in the price of diesel oil, and thus a steeper decrease in demand, than it will for gasoline.

Although the exact effects of internalization of external costs on the decrease in production of CO_2 emissions and other noxious substances are not known, there is no doubt that the effect would be positive. It is impossible to quantify the scale of the effect since cases of its implementation have been so rare. Still, a rapid practical implementation of internalization of external costs of transport can only be recommended. Further hesitation means a further increase of the environmental debt of transport, and further growth of the costs that will have to be covered at the end of the day.

CONCLUSIONS

Although the Czech Republic is currently experiencing rapid motorization and the general shift of modal split from public transport to individual car transport, these trends are also working against national and local efforts to reduce the impacts of the transport sector on climate. If the emissions of CO_2 from transport are to be further reduced, it is desirable not to implement the country's Motorway and Road Construction Programme to its full extent, but rather to invest in maintenance of existing infrastructure and to upgrade it carefully, so as not to encourage additional energy consumption.

A reduction in the volume of individual car transport will also help improve public transport so that it meets people's expectations and needs. Also, it was found that without a decrease in individual transport, the development of public transportation could not lead to a net reduction in energy consumption and CO_2 emissions.

The market in which the transport system operates is distorted and unjustly favors individual transport. Only when equal market conditions are restored in the transport sector, through the full internalization of external costs, will public transport be able to fully compete with individual transport. Until then it will seem expensive compared to individual transport.

Conclusions and Recommendations

The evaluation of the benefits, in the form of a reduction in emissions of CO_2, of the measures in the transport sector that are included in the *Second*

Communication of the Czech Republic to the *UN Framework Convention on Climate Change*, yields the following major findings:

The Biodiesel and Combined Transport measures are examples of desirable policies and measures with strong potential for CO_2 emission reductions. The support of biodiesel production is a relatively successful government program, while the government's support for combined transport could be much stronger. If greater support is given to the development of combined transport facilities and networks in the near future, the impact on reducing the CO_2 emissions will be far more significant.

There is one provision in the *Second Communication* whose impact on CO_2 emissions could be devastating if it were to be fully implemented. The inclusion of the provision entitled, "Optimization of traffic on certain trunk roads and construction and modernization of bypasses and their feeder roads," appears to be misguided. This provision leads to an increase in the volume of CO_2 emissions. There are two principle reasons for this. First, new road infrastructure tends to lead to growth in road traffic, and second, an increase in the speed of the traffic on new high capacity roads leads to a significant increase of energy consumption and thus CO_2 emissions. Expected technological advances in automobile fuel efficiency only partially compensate for the influence of these two factors. Therefore, we recommend that this provision be omitted from the *Third Communication.*

The other two provisions, "Support to Development of Public Transport," and, "Internalization of External Costs," could make essential contributions to reducing the volume of CO_2 emissions. Their degrees of practical implementation differ greatly. The success of the former policy depends vitally on implementation of the latter. This measure is able to stop the growth of the largest source of CO_2 emissions within the transport sector — automobile transport. Nevertheless, because this is a highly unpopular topic among politicians, and the prevailing opinion is that cost internalization should take place within the context of pan-European measures, there has been almost no progress in this area. It is vital, therefore, that concrete measures toward the full internalization of the external costs of transport be taken as soon as possible.

Endnotes

1 This report is a condensed version of a longer report by the same authors, which contains a more extended discussion of the policies presented in the *Second Communication*, along with more detailed data and calculations. The full report is available from the Centre for Transport and Energy.

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7 Estimating the volume of transit flow, however, is difficult if not impossible because it depends on the distance between the border crossings the hauler chooses (the minimum distance suitable for combined transport is currently about 500 km) and on the amount of freight transport. The Czech Republic is currently, due to truck transit reduction measures in neighboring countries, exposed to an overload of truck transport. If such restrictive measures were also applied in the Czech Republic, the volume of truck transit could be reduced significantly.

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15 Navrh reseni Oleoprogramu pro obdobi roku 2001 a dalsi roky (c.j. 1987/300/2100/320/00). MZP CR, Praha 2000 (approved by the Government in the second half of 2000).

16 Pokorny, Z. Bionafta — ekologicke alternativni palivo do vznetovych motoru. MZe CR, Praha 1998.

17 Ibid.

18 The current price of conventional diesel fuel is about 22 CZK (approx. 0,64 EUR).

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Hungary
Credit Mechanisms for Improving Energy Efficiency

FERENC LACZO

Introduction

AIM OF THIS STUDY

The purpose of this study is to describe three credit mechanisms for encouraging improvements in energy efficiency implemented in Hungary since the 1990s — the Energy Saving Credit Fund (ESCF), the Energy Saving Credit Program (ESCP) and the Energy Efficiency Co-Financing Scheme (EECfS) — and to assess their relative contribution to Hungary's overall progress toward reducing GHG emissions in the period since transition from socialist rule.

These programs are financed partly from national government budgets and partly by foreign donors. They involve a wide range of sectors including business organizations, public services (owned by local self-governments or by citizen associations) and residential communities. Although the participants appear to have been motivated chiefly by the economic benefits offered by energy conservation, these programs have achieved significant reductions in GHG emissions and provide experience applicable to other economies in transition.

TRENDS IN HUNGARIAN ENERGY CONSUMPTION AND GHG EMISSIONS

The efficiency of energy use in Hungary is well below the norm for Western Europe, but compares favorably to that of its neighbors in Central and Eastern Europe (see Figure 1). This is, in part, because the country's shortage of indigenous energy resources encouraged attention to energy conservation even under socialist rule.

As elsewhere in Central and Eastern Europe, energy consumption and GHG emissions have fallen markedly since the late 1980s. Initially these reductions were due largely to the rapid decline in economic output. From the mid-1990s, however, output rose, to regain pre-transition levels by 1999. Meanwhile, energy consumption and GHG emissions have stabilized or slowly fallen. Emissions of carbon dioxide stood at 60,703 tons in 1999,[1] a reduction of roughly 20 percent from the years 1987-1989 (see Figures 2 and 3).

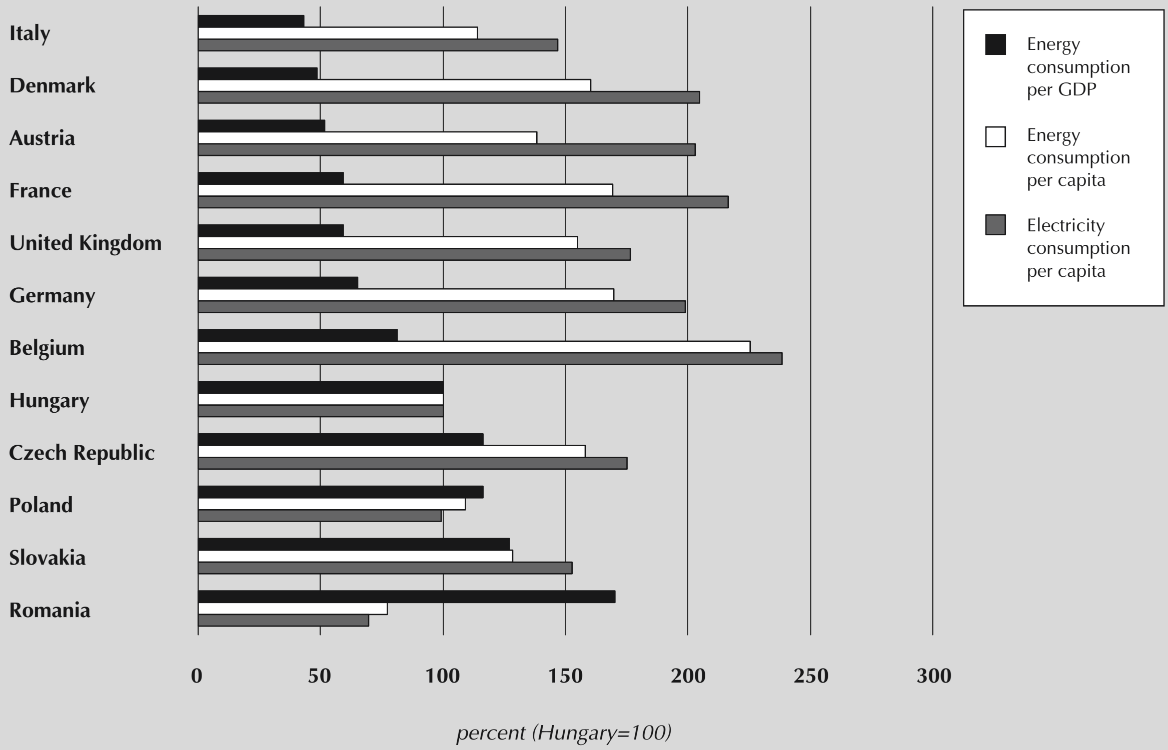
Figures 2 and 3 indicate that Hungary has achieved significant gains in energy use intensity. The country's reduction in carbon dioxide emissions is greater still due to a shift from coal to natural gas and (to a lesser degree) increased use of renewable energy resources. The key force driving these changes has been the restructuring along market lines of the economy in general and of the energy sector in particular. While these changes — such as privatization, the closure of unprofitable heavy industry and energy price liberalization — were motivated by economic rather than environmental goals, recent years have seen increasing official recognition of the need to take additional steps specifically targeted at energy efficiency, environmental benefits and climate change mitigation.

NATIONAL ENERGY POLICIES

In the early 1990s, the government withdrew funding from energy conservation programs, concentrating its attention on the reform of the economy through privatization and price liberalization. These policies impacted the Hungarian energy sector, both indirectly and directly, by providing actors in the economy at large with greater incentives for energy

FIGURE 1

Energy consumption in selected countries in 1997



Sources: *Environmental Statistical Data of Hungary*, 1997, 1998 and 1999, and data provided by the Energy Center

efficiency and by requiring the privatization of much of the energy supply and distribution. By the end of 1999, large parts of the energy sector had been privatized. As part of the process, energy prices were increased markedly (although the government retains a strong role in regulating prices) in order to create conditions for profitable operation — a trend that made implementation of energy saving programs attractive for major consumers. Further liberalization is envisaged to bring Hungary in line with requirements for EU accession.

Although these changes have had profound effects on energy consumption since the mid-1990s, the government has recognized that the transition towards the market economy is not in itself enough to ensure a sound energy regime, and that market mechanisms must be supplemented by state intervention if energy conservation goals are to be met. In addition, the 1992 UN Convention on Climate Change led policy makers to incorporate the need for GHG reductions into national economic and energy policy.

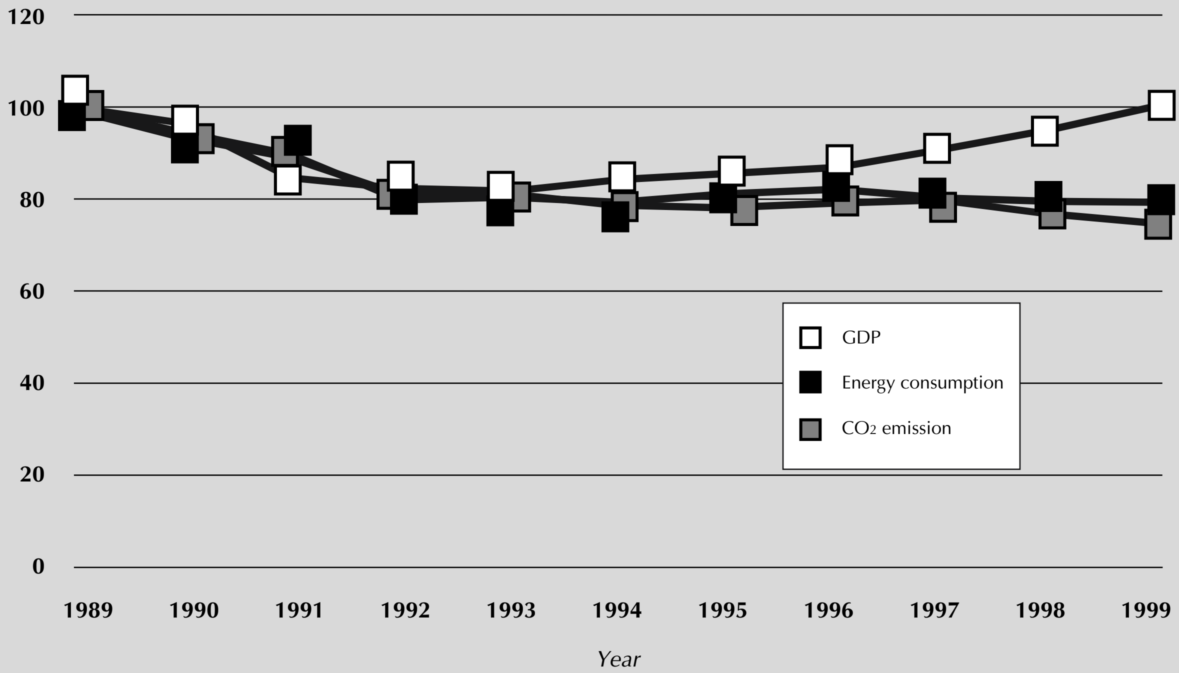
Hungary has not ratified the Kyoto Protocol, but agreed to do so at a meeting of environmental ministers of the Visegrad countries (that is, the Czech Republic, Hungary, Poland and Slovakia) held in Bojnice, Slovakia, in May 2001, before the Rio +10 Summit in 2002. Hungary is working on measures to meet the emissions targets set by the Protocol, a goal embodied within the 10-year policy for improving energy efficiency launched in 2001.

The basic legal framework governing energy policy is based on a Parliamentary Resolution prepared by the Ministry of Industry and Trade and approved by Parliament in 1993. The bill sets forth the following strategic objectives:

- to diversify energy supplies and to reduce dependence on the states of the former Soviet Union for energy imports;
- to protect the environment by minimizing pollution from energy combustion;

FIGURE 2

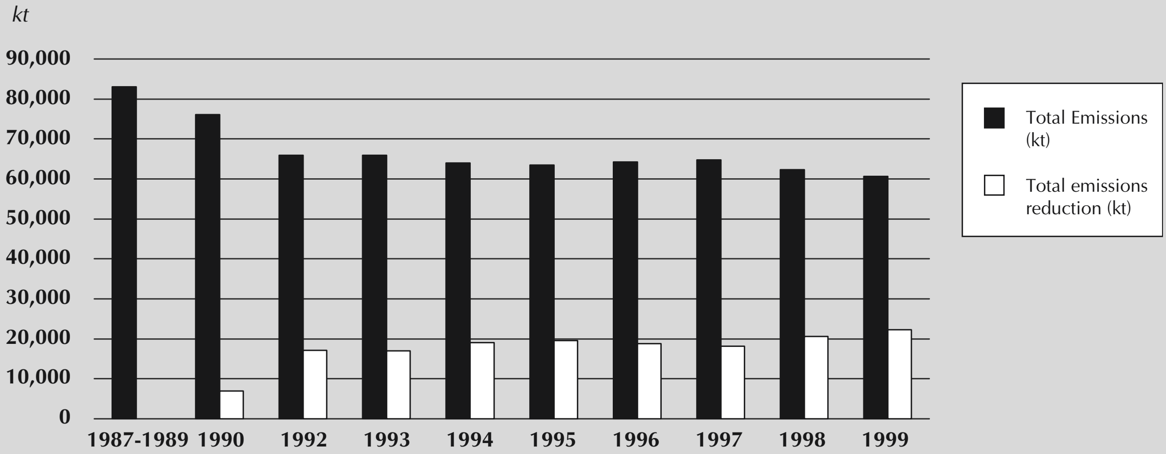
Energy consumption and CO_2 emissions 1989-2000



Sources: *Environmental Statistical Data of Hungary*, 1997, 1998 and 1999, and data provided by the Energy Center

FIGURE 3

Emissions and emission reductions of CO_2 in Hungary 1990-2000 in kilotons
(1987-1989 emissions baseline)



Sources: *Environmental Statistical Data of Hungary*, 1997, 1998 and 1999, and data provided by the Energy Center

TABLE 1

Financial history of the Energy Saving Credit Fund (in million HUF)

	Fund from GCA	*Interest rate from deposit of ESCF*	*Repayment of credit with interest added*	*Total income of the ESCF*	*Granting of credit*	*Operating expenses*	*Total expenses of the ESCF*
1991	859.2	109.1	0.7	969.0	56.6	4.2	60.8
1992	263.1	238.1	81.2	582.4	358.8	12.3	371.1
1993	2.9	212.7	208.0	423.6	689.1	13.0	702.1
1994	0.4	188.9	554.8	744.1	1,331.8	18.0	1,349.8
1995	0.0	53.7	661.2	714.9	808.0	16.1	824.1
1996	0.0	34.8	1,198.3	1,233.1	1,245.7	23.3	1,269.0
1997	0.0	58.3	1,327.4	1,385.7	878.4	17.8	896.2
1998	0.0	85.8	1,272.0	1,357.8	1,573.9	31.4	1,605.3
1999	0.0	45.5	1,196.7	1,242.2	1,439.7	27.7	1,467.4
2000	0.0	11.7	1,375.7	1,387.4	1,425.4	34.1	1,067.5
Total	1,125.6	1,038.6	7,876.0	10,040.2	9,807.4	197.9	10,005.3

Source: Data was provided by the Energy Center (2000)

- to increase energy efficiency through the modernization of energy supply structures and demand-side management programs;
- to improve public acceptance of new energy facilities by increasing information dissemination to the general public; and
- to attract foreign investment in capital-intensive energy projects.

The energy saving credit lines discussed in the sections below are important mechanisms for the achievement of these national goals and international commitments. Although their impact has been limited by comparison to the macroeconomic changes discussed above, these programs have the particular value of reaching sectors of the economy, such as local government, that would otherwise lack the funding needed to make energy saving investments.

THE INSTITUTIONS GOVERNING HUNGARIAN ENERGY POLICY

The Ministry for Economic Affairs is responsible for the implementation of energy policy, energy strategy, energy efficiency measures, foreign trade, energy regulation (including setting prices and taxes), environmental protection associated with energy generation, and renewable energy resources.

The Ministry for Economic Affairs shares its responsibility with the Finance Ministry on energy tax policy.[2] The Ministry of Environmental Protection shares responsibility with the Ministry for Economic Affairs on environmental protection issues associated with energy use, while the Ministry of Transport, Telecommunication and Water Management has primary responsibility for energy transport policies, including its environmental impact. All of these ministries, as well as additional departments, are involved in the operation and decision-making in regard to energy saving programs.

The Hungarian Energy Information Agency was founded in 1996 by the Ministry of Industry and Trade following the reorganization of the State Energy and Energy Safety Inspectorate. As well as being a major player in Hungary's energy saving programs, the Agency collected and processed data on energy supply and consumption, and provided regular statistical analyses of energy use for the Ministry for Economic Affairs and for the International Energy Agency. This agency was also responsible for studies concerning energy and economics. In addition, the

TABLE 2

Effectiveness of ESCF funded investments by project type
(in order of cost effectiveness)

Project description	*# of projects*	*Total cost (in million HUF)*	*Granted credit (in million HUF)*	*Energy saving (tJ/year)*	*Effectiveness of credit (tJ/million HUF)*	*Cost-effectiveness of total investment (tJ/million HUF) [year 2000 HUF]*
Modernization of the manufacture of energy saving equipment and machinery	4	24	18	170.6	9.48	7.11
Waste-heat utilization	14	402	303	500.4	1.65	1.25
Utilization of industrial, agricultural and forestry by-products for energy production	33	1,349	858	1,428.5	1.66	1.06
Reduction of heat loss through improved insulation	1	3	3	1.8	0.71	0.60
Regulation and automation of energy production process and equipment	4	126	104	66.6	0.64	0.53
Optimization of energy usage through measurement, data processing and process regulation	3	123	81	62.8	0.85	0.51
Promotion of energy saving in heat distribution systems	10	162	130	82.2	0.63	0.51
Application of energy saving technologies and production systems	38	1,611	1,044	736.5	0.71	0.46
Development of co-generation systems	16	1,758	778	791.4	1.02	0.45
Modernization of energy transformation equipment, distribution mains and heating systems	222	5,988	4,353	2177.5	0.50	0.36
Modernization of lighting systems	133	2,667	1,909	744.8	0.39	0.28
Development of complex energy saving in energy supply	4	158	124	36.0	0.29	0.23
TOTAL	**482**	**14,373**	**9,705**	**6,799.1**	**0.70**	**0.473 [0.25]**

Source: Data provided by the Energy Center (2000)

Hungarian Energy Information Agency managed the project proposals of both the Energy Saving Credit Fund and the Energy Saving Credit Programs.

The Hungarian-EU Energy Center ("The Energy Center") was established in 1992 as part of a joint initiative between the Hungarian Government and the European Union to promote energy conservation and energy efficiency in Hungary, and to strengthen cooperation between Hungary and the EU on energy issues. The Energy Center managed several energy saving programs — among these the Energy Efficiency Co-financing Scheme and renewable energy pilot projects — and coordinated a small training program connected with renewable energy resources. On April 7, 2000, the Hungarian government united the Hungarian Energy Information Agency and the Energy Center to establish the Energy Center — Energy Efficiency, Environmental Protection and Energy Information Agency Public Company. This governmental resolution has assigned responsibility for managing the Energy Saving Credit Fund, the Energy Saving Credit Program and the Energy Efficiency Co-Financing Scheme to the Center.

Evaluation Criteria

The material and analysis presented in this paper are based on project descriptions and figures provided by the energy credit programs. We evaluate these programs (and their components) according to the following quantitative criteria:

- cost of credit granted for implementation of energy saving projects (in Hungarian forints [HUF]);
- total cost of project implementation (in HUF);
- financial ("complex") payback period — total financial cost of project/financial value of savings per year (measured in years);
- energy savings per year (measured in terajoules);
- credit granted as a proportion of the total cost of project investment;
- cost-effectiveness of energy savings — energy savings per year/cost of credit granted (measured in terajoules per million HUF);
- overall cost-effectiveness of energy savings — energy savings per year/total cost of the project (measured in terajoules per million HUF);
- CO_2 equivalent emissions reduction (measured in kilotons per year); and
- cost-effectiveness of GHG emissions reduction — reduction in CO_2 equivalent/total cost of the project (measured in kilotons per million HUF)

The task of comparing the cost and cost-effectiveness of the various energy saving investments is complicated by the rapid (albeit decreasing) inflation that Hungary experienced over this period. If measured in Hungarian forints, projects completed earlier will appear more cost-effective than those completed later since the purchasing power of the forint dropped considerably in the course of the decade. Using published data on inflation and figures for which year expenditures were made, it is possible to estimate the value of expenditures made in a given year in terms of year 2000 HUF. We have made this calculation for the overall cost and cost-effectiveness indicators for each program. We have not done so, however, for expenditures under each project type owing to the lack of data as to which year these expenditures were made. It is not possible, therefore, to compare cost-effectiveness measures between projects undertaken within one program with those undertaken within another. Furthermore, the comparison of cost effectiveness between project types within each program is only valid if it is assumed that expenditure on these projects was more or less evenly distributed over the lifetime of each program. This is likely to be true where projects were numerous but not likely when a small number of projects were involved.

Although aggregate data for these criteria was available for all three of the programs, data regarding specific project components was not available for the EECfS. We, therefore, analyze the relative performance of specific project components for the ESCF and ESCF only, before comparing the aggregate performance of all three programs.

Energy Saving Credit Fund

OVERVIEW

At the beginning of 1991 the Government of the German Federal Republic provided around DEM 50 million of coal to the Hungarian government to alleviate the energy shortage Hungary was then experiencing. After the coal was sold on the Hungarian domestic market, the German government initiated the Energy Saving Credit Fund with the Hungarian government, a program which would use the income generated from the sale to encourage energy conservation. The Hungarian government is said to have allocated around 60 percent of this income (DEM 30 million) to the Fund.

The Fund was launched on August 1, 1991. From 1991 to 1995 it was managed by the Hungarian Ministry of Trade and Industry. From 1996 the Hungarian Entrepreneur Development Foundation oversaw the Fund, but actually the project was managed by the Hungarian Energy Information Agency. From 2001 the Energy Center took control of the Fund's organization.

TABLE 3

Performance of projects funded by the ESCF and the ESP's district heating credit program, 1997-1999 (2000)

Project description	*# of projects*	*Total cost (in million HUF)*	*Granted credit (in million HUF)*	*Energy saving (tJ/year)*	*Effectiveness of credit (tJ/million HUF)*	*Cost-effectiveness of total investment (tJ/million HUF) [year 2000 HUF]*
Waste-heat utilization	3	103	58	40.5	0.70	0.39
Establishing co-generation systems	1	97	30	32.5	1.08	0.34
Decreasing energy loss by thermal insulation	14	112	101	32.0	0.32	0.29
Utilization of renewable energy resources, industrial, agricultural, forestry waste and by-products	6	132	115	35.6	0.31	0.27
Modernization and optimization of energy transformation equipment, distribution networks and heating systems	197	2,737	2,194	549.2	0.25	0.20
Modernization of lighting systems	15	190	165	33.9	0.21	0.18
Introduction of energy saving technologies and production systems	3	30	27	3.0	0.11	0.10
Local government, 1997-1999	239	3,401	2,690	726.7	0.27	0.21
Local government, 2000	83	1,234	804	198.1	0.25	0.16
Local government, 1997-2000	322	4,635	3,494	924.8	0.26	0.19
District heating program total	10	1,046	696	224.0	0.32	0.21
Total funds granted from the ESCP and the ESP's district heating program	332	5,681	4,190	1,148.8	0.27 (0.25)	0.20 (0.184)

Source: Data provided by the Energy Center

The technical management and processing of applications and projects was handled by the Hungarian Energy Information Agency until the Energy Center took over in 2001. Until 2000 a jury comprised of representatives of the Ministry for Economic Affairs ruled upon technical and economic parameters as well as the overall feasibility of the project. From 2001 an inter-departmental commission for energy conservation took over this role.

The financial management of the Fund is contracted out to ABN AMRO Bank, with the bank investigating the total financial risk on the loan. In practice, the bank's representatives can veto an application of which they disapprove.

TERMS AND ELIGIBILITY

The Fund provides loans on preferential conditions to legal entities, citizens and businesses for proposals that:

- decrease the specific energy needs of energy production, transportation and end-use;
- use and disseminate modern, energy-saving technologies;
- utilize waste heat and secondary products and waste for energy efficiency improvement purposes;
- regulate and measure the use of heat and hot water in flats supplied by district heating systems;

- moderate energy consumption by separating industrial, residential and communal consumers; and
- modernize outer, inner and public lighting systems.

Credit is granted for a maximum of six years, with a maximum of two "repayment free" years, at a below market interest rate (in 2000 this was set at 9 percent, at a time when the market interest rate was about 16 percent and inflation was running at 9.8 percent).[3]

The following financial and quantitative conditions apply:

- a project can receive a maximum of HUF 80 million credit;
- the credit cannot exceed 80 percent of the total investment expenditure;
- the completion time of the investment has to be within two years;
- the financial rate of return must be minimum 0.8 times the current prime rate of the central bank;
- the investment should result in a minimum of 100 gigajoules per year per million HUF in energy savings.

In evaluating applications, preference is also given to projects conducted by small and medium size enterprises, to projects that use domestically produced equipment, and where the applicant provides a high proportion of the cost.

FINANCIAL HISTORY OF THE CREDIT FUND

In total, HUF 1.1256 billion was received from the German Coal Aid (GCA) for use through the Energy Saving Credit Fund. The interest income received from the deposit of ESCF was HUF 1.0386 billion, increasing the credit fund total by some HUF 2.1642 billion. From the fund HUF 9.8074 billion in energy savings credit was granted to applicants over 10 years, and the GCA funding was circulated four and a half times as a positive result to energy saving (see Table 1).

The Fund only contains around 0.2 percent operating expenses compared to credit granted. Loss in the real value of the fund occurred, however, due to the ESCF's lower interest in comparison with inflation.

The nominal value of the Fund has been increasing by the rate of interest (i.e. half of the current prime rate of the central bank) after borrowing. The loans outstanding from the Energy Saving Credit Fund at the end of 2000 were HUF 3.4373 billion and the deposit left was HUF 34.9 million, giving a total of HUF 3.4722 billion. This amount was the nominal value of the ESCF at the end of 2000. If the original fund that came from the German Coal Aid (HUF 1.1256 billion) and the inflation rate (3.96 percent) were multiplied with each other, an amount of HUF 4.4562 billion at the end of 2000 will result. The difference between the actual amount and the calculated amount (which would have maintained the real value of the fund) is HUF 984 million or 22 percent. This loss in real value took place because the Fund's debit interest was a preferential one and was below the inflation rate.

EVALUATION OF RESULTS

The industrial, service and local-governmental sectors received up to 86 percent of the loans granted by the ESCF (The Energy Center, 2000). The effectiveness of the energy saving credit in the trade, industrial and agricultural sectors was above average, while projects implemented in the public sectors, including the transport, water management, education, health, sport and the governmental projects were generally the least effective.

The results of the program by specific types of projects funded are given in Table 2.

As these data indicate, modernization of energy transformation equipment, distribution mains and heating systems, application of energy saving technologies, and modernization of lighting systems together received around 75 percent of the total loan amount. However, the effectiveness of the loans in these three project types was below the average (0.357 terajoules per year per million HUF). Other project areas such as the development of cogeneration systems, utilization of industrial, agricultural and forestry by-products in energy production, and modernization of the manufacture of energy saving equipment and machinery received only 17 percent of the ESCF loans, although their cost-effectiveness was higher than average (0.763 terajoules per year per million HUF). However the possibility of implementing such projects on a larger scale is limited, partly because energy saving methods, such as the development of cogeneration systems or the use of by-products for energy purposes, are not convenient alternatives to more traditional methods.

TABLE 4

Comparison of aggregate performance of energy saving credit lines
(figures in year 2000 HUF are in brackets*)

	ESCF	*ESCP*	*EECfS*
Total project cost (million actual HUF)**	14,373	5,681	9,400
Credit granted in year 2000 HUF	(18,342)	(4,609)	(5,900)
Total cost in year 2000 HUF	(27,154)	(6,249)	(9,400)
Credit granted as % of total project cost	68%	73%	63%
Payback period (yrs)	2.65	4.5	3.63
Energy saved pa (tJ)	6,800	1,148	638
CO_2 reduction p.a. (kt)	720	77	110
Total cost-effectiveness of energy savings (tJ/million HUF) [3/1]	0.473 (0.250)	0.202 (0.184)	0.373 (0.068)
Energy cost-effectiveness of credit (tJ/million 2000 HUF)	(0.371)	(0.249)	(0.108)
Total cost effectiveness of CO_2 reduction (kt/million HUF) [4/1]	0.050 (0.027)	0.014 (0.012)	0.012 (0.012)
CO_2 reduction cost effectiveness of credit (kt/million 2000 HUF)	(0.039)	(0.017)	(0.019)
Number of Projects	482	332	76
Mean total cost per project (million 2000 HUF)	(56.3)	(17.1)	(123.7)

* To express the purchasing power of HUF spent at the time of actual project expenditures in terms of year 2000 HUF equivalent, ESCF costs were multiplied by 1.89; ESCP by 1.1; and EECfS, by 1.0.

** "Actual" means year in which investment took place

Energy Saving Credit Programs

OVERVIEW

Unlike the ESCF, the Energy Saving Credit Program was initiated by the Hungarian government itself following the adoption of the National Energy Conservation and Efficiency Promotion Program in December 1995. The resolution led to the development of the ESCP, which was launched in 1997, providing preferential loans for the implementation of energy conservation measures to local state-owned public facilities (schools, hospitals, social and health care buildings, etc).

In the year 2000 Hungary's energy saving credit program was expanded to form the Energy Saving Program (ESP). The updated ESP framework included a strategy to modernize the country's district heating by establishing a new credit program, using similar conditions to those applied by the ESCP.

The government did not provide a credit fund for the program. Instead, loans were provided by the commercial bank prepared to offer the lowest interest rate for energy saving credit projects. The Raiffeisen Bank, then the National Savings Bank, followed by the ABN-AMRO Bank and again the National Savings Bank have successively held the tender for credit provision. The government subsidizes the interest rate at which the credit is offered, with the cost covered by the special, governmental fund for economic development, which is managed by the Ministry for Economic Affairs. The credit available from the ESCP reached some HUF 800 million in 1997 while in 1998 and 1999 a HUF 1.1 billion credit existed. In 2000, HUF 1 billion was available from the ESCP and HUF 900 million credit was available from the ESP in regard to energy saving projects involved with mainly local government owned district heating systems.

While the technical aspects of the Energy Saving Program for district heating were managed by the Hungarian Energy Office, the assessment of project proposals was made jointly by the Energy Information Agency and the selected bank. The final decision on project proposal applications was made by the inter-departmental commission established by the Ministry for Economic Affairs.

In 2001 both credit programs were incorporated into the governmental Energy Saving Program, which offers direct investments rather than credits for projects with the same targets and fulfilling similar criteria. It is hoped that the new arrangement will prove less expensive compared to the cost of administering two separate energy saving credit programs.

TERMS AND ELIGIBILITY

The following types of bodies were eligible for loans under the program:

- local governments with sufficient assets to act as loan collateral;
- corporations and public companies owned exclusively by local government(s); and
- corporations undertaking energy saving projects for local government or public facilities owned by a local government.

The criteria for obtaining credit were as follows:

- The rate of return had to be at least 0.7 times that of the current prime rate of the central bank.
- Energy savings had to account for at least half the total cost savings produced by the project.
- A specific, minimum savings on primary energy use was required, therefore simple fuel switching projects (without efficiency improvements) were not accepted. The extent of this savings was not formally defined, but 100 gigajoules per year per million HUF was accepted as a reasonable figure.
- Implementation of projects was to be completed in less than 12 months.

The types of projects eligible for credit under the ESCP included those that:

- decreased specific energy intensity and loss from energy transformation and end-use by modernizing heat generating equipment and incorporating regulating instruments;
- applied energy saving equipment in heat and hot water use;
- lowered heat loss from outside doors and windows;
- decreased energy loss with thermal insulation;
- modernized indoor and outdoor lighting systems;
- applied cogeneration (i.e. combined heat and power) systems;
- used built-in heat-pumps to conserve energy;
- utilized renewable energy resources, waste-heat, by-products and waste.

In awarding credit, preference was given to the following factors in descending order of significance:

- The mitigation is significant and effective.
- The credit repayment is quick.
- The energy savings in relation to the credit granted is high.
- The energy savings investment is accompanied by the creation of jobs.

The terms under which loans were awarded by the ESCP were adjusted annually. In 2000 a project could receive a maximum of HUF 30 million credit (in the case of the district heating program HUF 50 million), with the total not to exceed 75 percent of the total project expenditure. The credit is granted for a maximum of five years with a maximum of two repayment free years. The interest rate is currently about half the prime rate of the central bank. The annual cost of providing these preferential terms is estimated to be between HUF 45-80 million. The applicants can receive normal commercial credit for the remaining 25 percent of the expenditure but at the normal rate of interest.

EVALUATION OF RESULTS

The cost, results and cost-effectiveness of the projects awarded funding by the two credit programs are detailed in Table 3.

Modernization and optimization of energy transformation equipment, distribution networks and heating systems dominated the Energy Saving Credit Program's activities (197 out of 332). This type of project had been implemented in the past and was highly feasible to implement. In terms of cost effectiveness, however, the relatively small number of projects implemented in the areas of cogeneration, thermal insulation, use of renewables and by-products, and waste-heat, performed better.

The Energy Efficiency Co-financing Scheme

OVERVIEW

The Energy Efficiency Co-financing Scheme was established within the framework of the Phare program for Hungary. The EECfS started operating at the end of 1998 with a Phare grant of around EUR 5 million (HUF 1.250 billion). The credit scheme is managed by the Energy Center in collaboration with two Hungarian banks: the Hungarian Commercial and Credit Bank and the Raiffeisen Bank. Money created through this arrangement initially stood at HUF 3.250 billion. In addition, the associated banks may channel financing from International Financial Institutions such as the European Investment Bank (EIB) into the Scheme.

A supervisory board — including representatives from the EU, the Ministry of Economic Affairs, the National Bank, the commercial banks and other authorities — is in overall control of the EECfS and has the right to propose changes in line with Hungarian energy policy objectives. Decisions regarding the awarding of loans are made collaboratively between the banks involved and the Energy Center. The participating banks determine whether applicants have an appropriate credit rating, while the Energy Center is responsible for the project's evaluation and coordination. A fund manager working for the Energy Center is nominated to help the banks determine whether a potential project is eligible for selection, particularly in terms of technical merit. The final decision on the project proposal is made by mutual consent between the bank and the Energy Center's fund manager.

TERMS AND ELIGIBILITY

Bodies eligible for obtaining loans from the Scheme include:

- private enterprises;
- local governments, public companies and establishments owned by local government; and
- NGOs providing public services.

Stakeholders not eligible include state-owned enterprises, companies not registered in Hungary, residential customers, energy producers, suppliers and distributors. Only projects implemented within Hungary are considered.

The project proposals eligible for credit include those which:

- modernize or replace power generation or transducer equipment;
- apply co-generation systems;
- use waste heat or secondary products and waste for energy efficiency improvement purposes;
- decrease utilization of energy supplying networks by creating reserve capacity and equalizing energy demand, etc.
- decrease electricity consumption by modernizing lighting and applying high efficiency engines;
- decrease energy intensity through the application of regulating techniques; and
- improve heat insulation.

The EECfS usually requires that an energy audit be conducted of the project site in order to justify the loan application and determine the potential for energy efficiency improvements.

The applicable financial terms and conditions include the following points:

- The applicants must cover 10 percent of the total expenditure from non-EECfS sources.
- An energy saving project can receive up to 25 percent of the eligible expenditure as an interest free loan from Phare funds.
- Money from Phare funds should not exceed 50 percent of the total credit.
- Phare funds must total a minimum of EUR 20,000 (about HUF 5 million) and cannot exceed EUR 400,000 (about HUF 100 million).
- Up to 65 percent of the total expenditure of the investment can be covered by bank credit, although International Financial Institutions funding limits vary. The EIB, for instance, cannot issue loans that exceed 50 percent of the total project expenditure.

- The credit is granted for up to eight years, with a maximum of three repayment free years.
- The credit may be granted in HUF, USD, DEM or EUR.[6]
- The non-Phare component of the loan is granted at a preferential interest rate.[7]

Owing to the strong demand for loans and the long payback period allowed (up to eight years), the Phare loan reserves have became exhausted. Circulation of these funds through continuous credit repayment and new project credit allocation, however, is still possible.

EVALUATION OF RESULTS

Forty percent of the successful applicants are local municipalities while the remaining recipients are mainly private businesses.

Projects for the upgrade of lighting, mostly street lighting, make up 40 percent of the total number of loans approved. This essentially means installation of sodium and compact fluorescent lamps in place of mercury, or in a few cases, incandescent filament lamps. Such projects achieve electricity savings of over 50 percent while meeting and often exceeding minimum standards of illumination.

A small number of projects involve establishing or increasing combined heat and power generation, mainly by installing gas engines. In nearly 15 percent of the cases the focus is to enhance (through altering or replacing) technological and production processes, including, for example, refrigeration equipment improvement. Two projects are based on the increased use of renewable energy sources (that is utilizing geothermal water for a district heat supply and generating electricity by using biogas from the wastewater treatment). The remaining 40 percent of projects mostly involve industrial plants introducing more rational systems of heat supply such as more efficient boilers, decentralized heat generation and/or change from steam to hot water to reduce distribution losses, and gas radiation heating. These examples which are all combined with improved heating control systems.

The actual cost of all projects granted funding under the EECfS is EUR 37.6 million (HUF 9.4 billion), with a total of EUR 23.6 million or 62 percent of the total provided by EECfS credits and EUR 6.2 million or 16 percent of the total from the interest-free Phare component. The high share of non-EECfS financing indicates that the Phare grant has leveraged considerable investments in energy savings at relatively little cost to borrowers. By the same token, however, the small proportion of total expenditure provided by Phare funds means that the investments have been relatively costly for borrowers.

The total energy saving equals 638 terajoules per annum, equivalent to EUR 7.2 million or about 70 percent of the savings produced by the EECfS projects. The average payback period is 3.63 years. These projects cut CO_2 emissions by approximately 110 kilotons per year (Energy Center, 2000).

Comparative Analysis and Conclusions

All three of these programs comfortably outperformed the minimum criteria set for loan approval (regarding, for instance, the proportion of funding derived from other sources and the requirements for minimum cost effectiveness of energy savings of at least 100 terajoules per million HUF). However, the figures given above indicate significant differences in the comparative performance of the schemes. The environmental cost-effectiveness of the three schemes can be ranked according to their date of inception: that is, the ESCF performed best, followed by the ESCP and finally the EECfS.

Finally, the ESCF was effective in using a relatively small initial investment (derived from the sale of German coal aid) to create an investment fund with significant positive impacts on Hungary's energy sector.

The three schemes generated annual savings of 8,585.9 terajoules of energy and 907 kilotons of CO_2 as of the year 2000 for a total cost of HUF 42.8 billion in year 2000 HUF (approximately USD 170 million). Unfortunately currently available data and analytic methods do not permit a financial value to be assigned to this emissions reduction. These figures are equivalent to 1.4 percent of Hungary's 1999 energy consumption and 1.5 percent of its CO_2 emissions. Perhaps more significantly, these schemes account for almost 6 percent of the 15,339-kiloton reduction in emissions achieved between 1992 and 1999. The new energy policy introduced by the government in 2001 plans to build upon this record by providing energy saving programs with HUF 50 billion over the next 10 years. In combination with the energy saving programs already in operation, it is estimated that this investment will help Hungary to achieve a 5,000-kiloton or 8 percent reduction in its carbon dioxide emissions by 2010.[8]

Endnotes

1 Preliminary data provided by the Ministry for Environmental Protection.

2 After all, the energy prices and taxes are regulated by Parliament and approved in the framework of the state budget.

3 The interest rate for the loans with these conditions is half of the current prime rate of the central bank; 3 percent is added onto the interest rate to cover bank expenses and 0.5 percent is added for technical supervising and controlling expenditure. As the prime rate last year was 11 percent, the interest rate for this credit was in total 9 percent (5.5+3+0.5). (The interest rate for a loan is variable. For example, if the prime rate of the central bank decreases the repayment charge decreases also.)

4 The data are measurements. There is a check after the implementation and if necessary the data are corrected. This correction in some cases has not been made because some projects have not been completed.

5 We use the past tense in this section as the Energy Saving Credit Program was completed in 2001. The last deadline for submission of project proposals was January 31, 2001. The program continues not as a credit program, but as a direct energy saving investment subsidy program with the same target and with similar criteria.

6 Phare funds are distributed in EUR but are paid back in HUF at the current exchange rate. Credit granted in HUF, however, would be paid back in this currency. For credit granted in a foreign currency (i.e. in USD, DEM or EUR) the payback currency would depend on the agreement between the applicant and the bank (paid back in foreign currency or HUF).

7 The rate depends on the basic rate of interest of the central bank and the actual interbank (IB) rate of interest and includes an extra 0.5 percent charge. In terms of credit being granted in foreign currency (e.g. in EUR, DEM and USD), the London interbank interest rate (LIBOR) plus a 0.5 percent charge affects the preferential rate. In addition, an interest rate margin is added to the interest rate with increasing project implementation time, being 2 percent for the first five years and 2.5 percent when more than five years is needed to pay back the project credit.

8 Source: 1107/1999. (X. 8.) Korm határozat a 2010-ig terjedo energiatakarekossagi es energiahatekonysag-novelesi strategiarol (Governmental Resolution on the Energy Saving and on the Strategy for Increasing of Energy Efficiency Until 2010)

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Poland
Policies and Measures in the Energy Sector

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Introduction

AIMS AND SCOPE OF STUDY

This study of the policies and measures undertaken to meet Poland's commitments under the United Nations Climate Change Convention (UNFCCC) and the Kyoto Protocol has two major goals. First, it outlines the major policy options for the reduction of greenhouse gas (GHG) emissions by the energy sector — diversifying the types of fossil fuel used as primary energy sources, increasing energy use efficiency and increasing exploitation of renewable energy sources (RES) — and assesses their relative value according to a series of qualitative criteria developed by the authors. We conclude from this analysis that given the broad range of benefits offered by renewable energy sources, government policy is not presently giving sufficient priority to this option. Second, the report describes four renewable energy projects, evaluating them according to their environmental benefits and cost of implementation.

This report focuses on the energy sector owing to its high relative contribution to Poland's overall GHG emissions and poor environmental performance relative to other industrialized countries. As in other CEE countries, energy production's share of national emissions has changed little over the past decade and, at 54 percent in 1998,[1] remains higher than that typical of Western industrialized countries despite the marked fall in total GHG emissions after the transition from a centrally planned economy. (See Figure 1.) Although the modernization of the energy sector began in the 1990s, the energy efficiency per unit GDP in Poland is still significantly lower than in most OECD countries, indicating opportunities for further substantial reduction of greenhouse gas emissions in this sector.

The priority we give to the energy sector may also be justified in terms of its other adverse impacts on the environment. The sector is responsible for more than 63 percent of Poland's total emissions of sulfur dioxide (SO_2), 41 percent of nitrogen dioxide (NO_2) emissions and about 30 percent of dust. It is also the source of about 49 percent of all the industrial waste generated every year in Poland and causes geomechanical and hydrological transformation of soils, disturbances of the water regime through mining activities, and heavy pollution of surface waters owing to the discharge of saline mining waters and cooling waters from power plants directly into rivers.

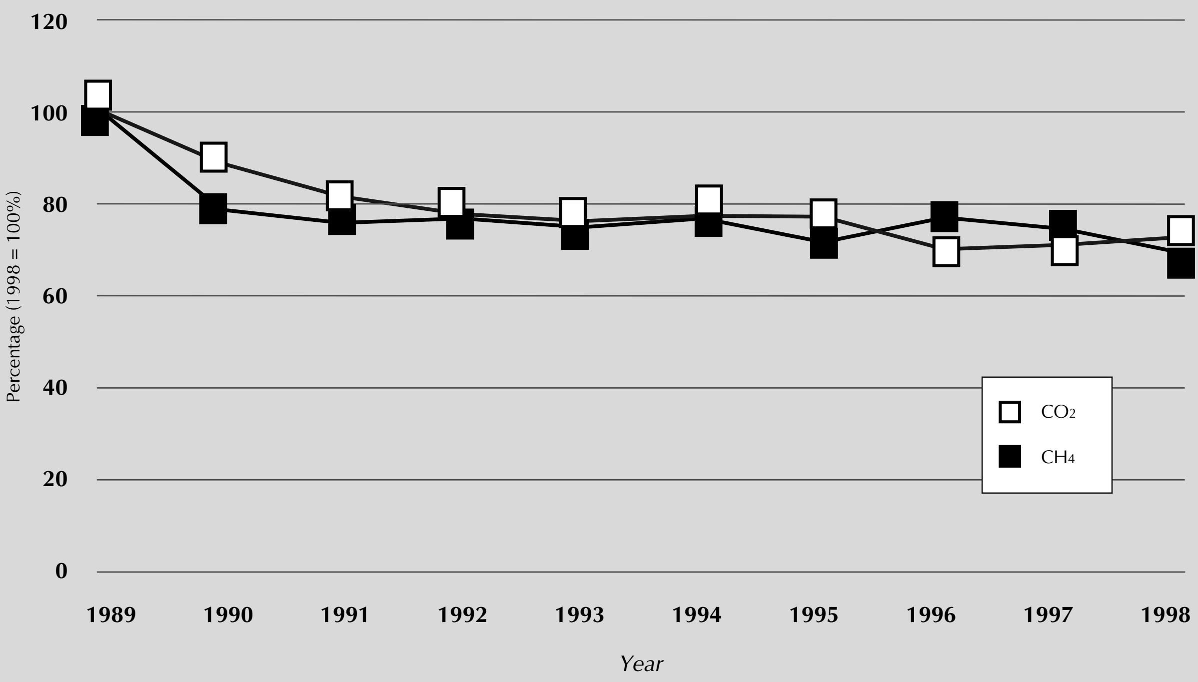
It follows, therefore, that the choice of best policies and practices adopted to mitigate the energy sector's contribution to climate change should also be determined by a general appreciation of the sector's environmental impacts. In the body of this paper we will identify policies and measures that support the achievement of a broad range of environmental objectives in addition to those directly related to GHG reduction.

GOVERNMENT POLICY ON CLIMATE CHANGE

At present climate policy is not a priority for the Polish Government as indicated by the lack of a national strategy on GHG emission reduction.[2] Nor has a specific action program been formulated to address the requirements of the Climate Convention. Some elements of climate policy are contained in the *National Environmental Policy* adopted by Parliament in 1991 and revised as the *Second National Environmental Policy* in 2000 (NEP). The latter document contains several direct references to the need to take action to reduce greenhouse gas emissions. Among other things it envisages:

FIGURE 1

Changes in the emission levels of CO_2 and CH_4 in Poland in 1988-1998



Sources: *Environmental Protection 2000,* Main Statistical Office (GUS), Warsaw 2000 and the authors' own calculations.

- Poland's active participation in addressing global environmental problems, including in particular the Climate Convention forum;
- ratification of the Kyoto Protocol as an immediate priority for environmental policy;
- implementation of the requirements of the Kyoto Protocol, the halving of energy intensity of the national product and the wide introduction of the best available techniques for improving energy efficiency and exploiting renewable energy sources (these goals are medium-term priorities to be implemented by 2010);
- development of a national strategy on greenhouse gas reduction and enhanced energy efficiency (as an element of the implementation program for the Second National Environmental Policy;
- inclusion of a number of greenhouse gases such as methane, HCFs, PFCs and SF_6 within the range of pollutants subject to reduction measures.

To date, however, these goals have not been implemented as policies and measures with practical impacts on the energy sector.

The Ministry of the Environment[3] is currently considering the creation of a quota system for CO_2 emissions applicable to major electricity producers and the implementation of a legal regime for emission trading within Poland, as well as an imposition of fees for emissions at a level not exceeding the price of emission reductions on the international market. However, the preparations for introducing these instruments have not gone beyond the stage of research. The Ministry's proposal in 1999 to impose a product charge on fuels (which may be recognized as a form of carbon tax) met with strong opposition from the industrial lobby and, as a result, never entered into force.

At present, therefore, the only policy measure specifically focused on climate change that has so far been implemented is the fee for CO_2 and methane emissions levied since 1993 on economic entities. While this measure may represent an important first

TABLE 1

Evaluation of NEP and NC climate protection policies for energy sector
(Prepared by the authors)

	Fossil fuel diversification	*Improved energy efficiency*	*Increased RES use*
Compliance with UNFCCC and KP	+	+	+
Compliance with NEP	+	+	+
Extent of GHG reduction	+	+	+
Sustainability of reduction	0	+	+
Reliability of verification of emission reduction	+	+/-	+
Additional environmental benefits	+	+	+
Reduction cost	-	+	+
Monitoring cost	+	+	+
Educational effect	-	+	+
Job creation	-	0	+
Social and political sensitivity	0	0	0

step toward a more active climate policy in the future, at present the fees may be too low (at about USD 0.045 per ton for both CO_2 and CH_4) to provide an incentive for investments in GHG emissions reduction. Currently, the most important instrument of the national environmental policy, with the potential to be used to implement investment projects to reduce greenhouse gas emissions, is the system of preferential credits and grants provided by the environmental funds (mainly NEF and EcoFund).

Thus, the significant reduction of CO_2 emissions achieved since 1988 is not so much an effect of a specific climate policy as it is a side effect of economic restructuring and the implementation of environmental protection programs, such as measures to reduce sulfur dioxide emissions, not specifically focused on climate change. This situation is reflected in the official position of the Polish Government as presented in the 1998 National Communication (NC) to the Conference of Parties[4] where the following actions were recognized as the main policies and measures expected to reduce greenhouse gas emissions:

- reducing the energy and material intensity of industry by its restructuring;
- improving the energy efficiency of vehicle engines and promoting rail, combined and public modes of transport;
- improving heat insulation of buildings with a view to ensuring more rational use of heat energy;
- changing the fuel consumption structure in order to increase the share of hydrocarbon fuels, including a wider use of methane from coal beds and landfills;
- rationalizing the consumption of mineral fertilizers (including nitrogen fertilizers) in agriculture and increasing the share of organic fertilizers; and
- raising forests' capacity to act as sinks for CO_2 uptake by increasing wooded area and improving forest health.

Considering the NEP and NC together, we can identify three major directions being pursued by national policy makers for mitigating the energy sector's contribution to GHG emissions:

- fossil fuel diversification by significantly increasing the use of oil and gas as fuels for energy production at the expense of coal (NC);
- improving energy efficiency in energy production and consumption as a consequence of industrial restructuring and the energy conservation (NEP, NC); and
- increasing the use of renewable sources of energy (RES)(NEP).[5]

As we discuss below, to date far greater progress has been made with regard to the first two elements of this triad than the last, despite the government's theoretical commitment to RES.

Evaluation of National Policies in the Energy Sector

Our recommendations concerning the optimal policies for climate protection are based on an evaluation of their effectiveness, their economic costs and benefits, and their acceptability to the public. The set of criteria proposed by the authors of the present study consists of the following elements:

FORMAL CRITERIA

- **Consistence with the Convention and the Protocol.** As a signatory and party to the Climate Convention and the Kyoto Protocol, Poland should assess its measures against the requirements set out within these agreements to determine the extent to which these measures comply with their goals and formal provisions. Support should be given to those measures, which are consistent with the requirements of these documents.
- **Consistence with the National Environmental Policy and the strategy on the reduction of greenhouse gas emissions.** The basic document relevant to issues of environmental protection (including climate) in Poland is the NEP. Projects undertaken should reflect the stated priorities of the Policy (and, in the future, those of the strategy on the reduction of greenhouse gas emissions, which Poland has not yet developed). If, for instance, such documents prioritize the development of renewable energy sources over coal-to-gas conversion, then assessment of policies and measures should reflect this ranking.

ENVIRONMENTAL CRITERIA

- **The extent and duration of the reduction in GHG emissions.** The basic criterion for evaluating the measures should be the extent of the reduction of GHG emissions, both the absolute extent and in terms of the CO_2 equivalent.[6] It is also important to consider not only the extent of the annual reduction of the emissions of these gases, but also the time frame in which the measure envisaged will reduce emissions.
- **Sustainability of the reduction.** This criterion is related to but not identical to the previous one. It considers whether the policy in question is susceptible to unanticipated actions or events. For instance, could a shift in financial priorities reduce the economic viability of gas to the point that enterprises return to coal use?
- **The reliability of verification of the reduction.** It is quite difficult to predict changes in the reduction of greenhouse gas emissions. In projects which have not yet been implemented future emission levels have to be estimated. Another issue is the scope of analysis of the reduction. Should, for instance, evaluation of a coal to biomass conversion project include GHG generated by the transport of fuels from the place of their production to the place of their consumption? How easily may projects be monitored over time or actual attainment of predicted emissions levels be measured? These points are particularly important for Joint Implementation projects and emissions trading, as credit sharing arrangements depend upon reliable and continuous monitoring.
- **Additional environmental benefits.** Many GHG reduction projects have additional environmental benefits such as reductions in waste, wastewater or SO_2 or NO_x emissions. These benefits should also be taken into account in evaluating policy options.

ECONOMIC CRITERIA

- **Cost of GHG reduction.** Together with the extent of the reduction of greenhouse gas emissions, financial cost is the most important criterion for evaluation. It is self-evident that from the point of view of the national climate protection policy, the lower the cost of unit emission reduction the better.[7]
- **Cost of monitoring.** The cost of monitoring the project's effectiveness represents an additional, if less significant, financial expense. Here too, the lower the costs the better.

SOCIAL CRITERIA

- **Educational effect.** Measures to protect climate are frequently pioneering in nature, therefore, the educational effect of a given project is important.

Hence, the question should be answered whether projects are reproducible, and the extent to which their implementation has educational and dissemination values.

- **Effect on job creation.** Unemployment is a major social problem facing Poland. Therefore, the implementation of tasks in the field of climate protection should create jobs, or at least maintain existing employment levels.
- **Social and political acceptability.** This criterion is one of the most important for climate protection projects. Many projects may provoke opposition from local communities, for instance plans to close down a coal-fired boiler-house in a mining area. Such opposition has the potential to block project implementation. Assessing the likelihood of such opposition is a vital element in determining the viability of particular policies and projects.

In order to choose the instruments of climate protection policy that should be promoted in Poland, the government-proposed tools for such protection were evaluated using these criteria. These instruments were aggregated into three categories: shifts in the structure of primary fuel consumption (from solid fuel to hydrocarbons); increased efficiency in energy production and consumption; and increased use of renewable energy sources (see Table 1). These policies indicate all the measures and projects being proposed or implemented to reduce GHG emissions within the energy sector.

Table 1 presents the results of the informed assessment of policy options conducted by the authors of the report that is based on their knowledge and experience and reflects the authors' viewpoints.[8] In this context, a policy which we considered met a given criterion or had a positive impact under this criterion is denoted "+"; one which did not meet a criterion or had a negative impact is denoted "-"; one that was considered neutral with respect to a given criterion is denoted "0"; one where the impact is unclear is denoted "+/-."

This assessment indicates that Poland's climate protection policy should be based on enhancing energy efficiency and increasing production from renewable sources of energy. In the following section, we review in more detail the main policies presently being carried out or considered by the Polish government in relation to the energy sector. We find that compared to fossil fuel diversification and increased efficiency of energy use, the development of RES has received inadequate attention. To date, no specialized government agency has been established to promote the development of renewable energy sources, and the scale and scope of special legal and financial instruments to support this development are far from sufficient. At present, a substantial part of old, local boiler-houses are now undergoing modernization. Given the very strong pressure of the gas lobby, natural gas is likely to be used in place of coal[9] while the potential contribution of RES may be neglected. Hence, it is necessary to offer good, proven examples of RES use at the local level — a task that we take up in the last section of this chapter.

Key National Policies

FOSSIL FUEL DIVERSIFICATION

Fossil fuels with high carbon content (hard coal and lignite) continue to dominate primary energy consumption in Poland. In accordance with Guidelines for Poland's Energy Policy,[10] the process of diversification of the sources of energy supply is motivated by considerations of both energy security and environmental objectives (to increase the share of less polluting energy sources in the energy balance). According to the Guidelines, the share of natural gas should grow significantly in the energy consumption structure (see Figure 2). In addition, the share of renewable energy sources is projected to grow somewhat in the energy balance.[11] In the long-term perspective these trends will contribute to Poland meeting its commitments under the Climate Convention.

The diversification of domestic supplies of the individual energy carriers, which took place during the 1990s, was facilitated by the expansion of the loading capacities of port-located oil terminals and the construction (or expansion) of gas pipeline connections — with the gas transmission system in Germany (providing net imports of gas of about 0.5 billion cubic meters per year), with Ukraine (1.0 billion m^3/year) and with Russia (the first line of the gas pipeline between Jamal and Western Europe). To reduce Poland's reliance on gas imported from Russia, the Polish government is now negotiating a long-term contract on gas purchases from Denmark (3 billion m^3/year) and Norway (a minimum of 5 billion m^3/year), which will involve the construction of another gas pipeline. However, RES are not being considered as an option for diversification.

TABLE 2

Annual GHG reduction resulting from implementation of renewable energy technologies (at discount rate i = 8%)

Rank	*Type of RES project*		*GHG unit reduction cost ['99PLN/ton]*
1	Solar air heating collector	40 m^2	-171
2	Small hydro-power plant	45 kW	-87
3	Solar water heater	4 m^2	-50
4	Landfill gas power generation plant	400 kW	-14
5	Municipal biogas installation processing wastewater sludge	320 kW_{el} plus 540 kW_{th}	-3
6	Landfill gas heat and power generation plant	550 kW_{el}, 700 kW_{th}	1
7	Straw fired district heating plant	1mW	6
8	Wood chips fired district boiler	500 kW	18
9	Wind turbine	2 x 600 kW	22
10	Hydro power plant with a newly-built weir	90 kW	40
11	Wood fired boiler	80 kW	46
12	Agricultural biogas plant	100 m^3	66
13	Straw-fired boiler	65 kW	77
14	Geothermal district heating plant	7,3 mW	106
15	Wind turbine	160 kW	250
16	Photo-voltaic lighting system	120 W	3,537

Source: Wisniewski G (editor). *Economic and legal aspects of renewable energy sources.* Expert study for the Ministry of Environment, EC BREC/IBMER, Warsaw 2000.

The corollary of reduced dependence on solid fossil fuel is the reform of the mining industry, which many governments have identified as a priority since 1989. Presently, the mining sector is still heavily subsidized by the state, with the industry's total debt exceeding USD 5 billion. The insulation of mining from market pressures has caused the overproduction of hard coal and undercut the price competitiveness of other fuels. In practice, however, the changes made so far have usually been of a cosmetic nature. One of the major barriers to restructuring has been the necessity for mass layoffs (the government's present plans call for the dismissal of 115,000 miners). Therefore, the reform started only at the end of the 1990s with the adoption and implementation of the government program called, "The reform of the hard coal mining in 1998-2002." Its main goal is to make the mining industry economically viable by reducing coal extraction by about 20 million tons and achieving profitability within the industry by 2002. According to the government, the program is going ahead as planned. In the long term, it is envisaged that the coal extraction level at Polish mines will stabilize in 2010 at 80-90 million tons per year (in the 1990s coal extraction averaged 135 million tons per year).

The implementation of this program will have a positive effect on the Polish balance of greenhouse gas emissions. In addition, the program has an environmental component, providing for instance for investment projects to reduce methane emissions from mines. Nevertheless, the government's long-term plans for the development of the electric power generation sector assume that the consumption of hard coal and lignite will stabilize or even grow over the next 20 years. The government does not plan to limit lignite extraction in order to reduce greenhouse gas emissions since lignite is currently the cheapest source of primary energy, and mines now in operation will yield resources for another 20 to 50 years. Therefore, the Guidelines indicate that "given the

TABLE 3

The environmental benefits of the District Hospital at Wejherowo project

	SO_2	Suspended dust	CO_2
Emissions from old boiler-house (tons/year)	80.7	322.8	11841.0
Emissions from new boiler-house (tons/year)	4.8	2.9	1340.0
Percentage reduction	94.0	99.1	88.7

predicted structure of primary fuels, the further (after 2012) reduction of greenhouse gas emissions may turn out to be too expensive and it may also diminish the competitiveness of the Polish economy."

We see, therefore, that under the criteria set out above, fossil fuel diversification has several shortcomings, particularly if given excessive emphasis in Poland's climate policy regime. Although this strategy offers the prospect of large emissions reductions and complies with the government's formal commitments, its long-term sustainability is questionable as it depends on the continuing availability of affordable imports of oil and gas. It is thus vulnerable to unfavorable shifts in international market or political conditions. Furthermore, cutting domestic coal production can only be accomplished at the expense of massive job losses within a highly politically mobilized sector of the workforce. Given these drawbacks it is surprising that the government is not paying more attention to RES as an option for energy diversification, which would foster job creation and local economic development.

INCREASED ENERGY EFFICIENCY

Two major government initiatives are likely to foster progress on this front: a) the liberalization and de-monopolization of power generation; and b) the rationalization of energy consumption.

De-monopolization of Power Generation

The electric power generation sector is undergoing a number of reforms aimed at restructuring it along market lines. Some of these changes may have positive effects on greenhouse gas emission levels. The main goal of these efforts is de-monopolization in order to create competition between independent entities, supplemented by the extension of regulatory supervision to those parts of the sector which constitute natural monopolies. In September 1996 the government adopted a plan of action entitled, "Demonopolization and Privatization of the Electric Power Generation Sector"; the Energy Law of 1997[12] is the basic legal act for this plan's implementation. The government aims to privatize all 33 distribution companies operating in Poland and will also sell off power plants and co-generators. At a later date, the plan provides for ownership changes in the gas industry (including the restructuring and sale of Polish Oil and Gas Company). At present, however, the privatization of the Polish electric power generation sector has not progressed very far.

The privatization and de-monopolization of this sector may favor the implementation of the long-term objectives of sustainable development.[13] Basic elements of the Energy Law affecting the CO_2 emission levels include: the establishment of an Energy Regulatory Agency to supervise the operations of enterprises in the fuel and energy sector; the rationalization of fuel and energy consumption as a result of the development of heat supply plans by local governments; and the creation of incentives to use renewable energy sources, waste heat recovery and combined heat and power production.

A key element of the market-oriented change underway in the energy sector is the gradual liberalization of energy prices. In 1996, regional differentiation of electric energy prices was introduced for distributors, extending to individual users the next year. Heat energy prices were liberalized in 1998. Under the provisions of the Energy Law, the tariffs for gaseous fuels, electric energy and heat energy should cover the legitimate operating costs of energy companies, including the environmental costs as well as the costs of demand management — that is, reducing energy consumption by users. In the long term, the increase in energy prices that will result will be a strong incentive to rationalize energy consumption, leading to the reduction of GHG emissions.

Support for Increased Efficiency in Energy Consumption

The municipal sector offers great potential for reducing greenhouse gas emissions. The reduction of emissions from this sector is being fostered by measures to rationalize heat energy use and the management of municipal waste and sludge from municipal wastewater treatment plants. In 1996, Parliament adopted the document, *Guidelines of the National Policy for the Rationalization of Energy Consumption in the Municipal and Household Sector*. On the basis of the guidelines formulated in this document work is underway to introduce higher heating efficiency standards in new buildings and to reduce energy use in existing buildings. The so-called, "Thermo-Modernization Act" (The Act on Supporting Thermo-Modernization Projects),[14] adopted in December 1998, set out the main direction of measures to implement the second objective.

The aim of the Act is to create a system of incentives and co-financing schemes for individual and institutional investors undertaking measures to reduce losses in local heating networks in order to partly or completely replace conventional energy sources by renewable energy sources and, above all, to reduce energy consumption in housing by improving heat insulation. It is estimated that these measures would allow a 7-14 million ton reduction in coal consumption, significantly improving the Polish balance of greenhouse gas emissions. The Act is of particular significance given the fact that the energy consumption in the municipal and household sector is two to three times higher than in West European countries with similar climate.

On the basis of the Act, the Thermo-Modernization Fund was established (based on the budget resources) to support the performance of energy audits, offer loans and pay premiums to those investing in thermo-modernization projects. The premiums, which are the main incentive for investors to take part in the program, may reach 25 percent of project costs. A review of the effects of the Act indicates,[15] however, that the results have been disappointing. In the period from January 1999 to September 2000, 341 applications for thermo-modernization projects were submitted, totaling PLN 34 million in value, of which about 200 projects were approved. It is estimated that the annual savings from heating cost reductions created by their implementation will reach about PLN 4.2 million. Most applications for the granting of premiums apply to single-family housing and are restricted in scale while no project has so far been submitted to replace traditional energy sources with renewable ones.

According to our previous analysis, increased efficiency in energy production and consumption satisfies all the listed criteria with the exception of its neutral ratings for job creation and social/political acceptability. Given its preponderance of advantages, energy efficiency must form a central part of Poland's GHG mitigation regime.

INCREASED USE OF RENEWABLE ENERGY SOURCES

The promotion of RES as a strategy for pursuing sustainable economic development was adopted as one of the priorities of the first *National Environmental Policy* (1991). The development of RES offers benefits, in addition to its positive impact on GHG emissions, including: reduced emissions of such pollutants as particulate matter, CO, NO_x and SO_2; more efficient use of natural resources; and reduced dependence on imported energy. Furthermore, this strategy offers important social benefits by creating demands for local labor and services markets and facilitating better public supervision and control of investment processes.

It is not the case that, as is sometimes thought, that RES is prohibitively expensive compared to other GHG reduction strategies. According to a recent study[16] renewable energy source technologies offer some of the least expensive options regarding greenhouse gas reduction in Poland. Their efficiency, divided into 16 groups of technologies, is shown below in Table 2.

Table 2 shows the unit reduction cost in 1999 PLN per ton of CO_2 equivalent for particular RES projects implemented in Poland. The types of projects are listed in order of increasing marginal cost per unit of GHG reduction. The first five projects carry a negative cost since they are profitable over the long term in simple economic terms (that is without taking GHG effects into account). The remainder involves a positive reduction cost.

The above data indicate that many RES technologies provide an economically feasible means of reducing GHG emissions. A similar conclusion follows from comparisons of costs of GHG abatement in various Activities Implemented Jointly/Joint Implementation (JI) projects. For example the SENTER,[17] a Dutch agency implementing pilot JI projects in CEE countries (including Poland), has financed investment projects related to renewable energy sources in which the reduction cost per ton of CO_2 equivalent was below USD 10. Generally, the least expensive projects where the reduction cost would fall even below USD 1 per ton of CO_2 equivalent were those employing renewable energy. The reduction cost for AIJ projects implemented to date in Poland ranged from USD 1 (use of biomass for power generation), through USD 4.6-64.2 (coal-to-gas conversion) to USD 26 and 130 (thermo-modernization and energy conservation). According to the World Bank estimates[18] the market will accept projects that involve reduction costs lower than USD 20-26 per ton of CO_2 equivalent.

Despite the economic feasibility of RES, their share of Poland's primary energy production remains small. Current estimates vary from 2.5 to 5 percent. Until recently, the Ministry of Economy, which is responsible for the energy sector, treated the development of RES sector as impractical claiming that RES available in Poland are negligible,[19] and that available RES technologies could not compete with traditional energy sources. Meanwhile, the actual and projected increase in gas consumption may threaten prospects for the development of renewable energy sources in Poland. As experience to date shows, gas is used to replace coal in small- and medium-sized energy generating installations where it would be easy to use renewable sources, but coal is not replaced at large power plants connected to the grid.[20]

In recent years, a slow change in government attitudes has taken place. The Energy Act includes a number of provisions favoring the development of renewables. For instance, the Council of Ministers is obliged to consider RES development in preparing the projections for the national energy policy; the Minister of Economy is empowered to require energy trading bodies to purchase some power and heat from RES, while the expenditures incurred to develop RES are to be reflected in the energy tariffs, which are presented for approval to the Energy Regulatory Agency.

In July 1999, Parliament, recognizing the range of social, economic and environmental benefits offered by renewables, obliged the government to develop a strategy on the development of the renewable energy sector. In response, the government began work on the *Strategy on the Development of the Renewable Energy Sector*, which was adopted by the Council of Ministers in September 2000. It presented specific measures to support the use of renewable energy sources. Policy discussions recognized the contribution that an active RES policy could make to Poland's implementation of international commitments under the Climate Convention and the Kyoto Protocol.

The main strategic goal presented in the Strategy is to increase the RES share in the country's primary energy consumption to 7.5 percent in 2010 and 14 percent in 2020.[21] Simulations performed using the SAFIRE model[22] indicate that if these targets are met, a net reduction in annual CO_2 emissions by 24 million tons can be achieved by 2010 and 37 million tons by 2020.[23] These targets are more modest than those of the European Union (which is aiming for a 12 percent share of renewable energy in 2010).[24] Nevertheless, if the target is to be achieved, greater impetus must be given to RES development, requiring national and local programs of direct support to be put in place.

The relative slowness with which the national government has moved to implement increased RES use within the energy sector suggests that the importance of making it a central part of Poland's GHG regime is as yet insufficiently recognized by national policy makers. Below we present four RES projects successfully implemented at a local level that illustrate the ability of RES to combine economic and environmental benefits.

Renewable Energy Projects

To identify good examples of renewable technology projects, according to the criteria listed above, the Institute for Sustainable Development created a database of projects for energy efficiency and the development of RES implemented in Poland in the 1990s. This study collected information from financing institutions, including the Ecofund, the National Fund for Environmental Protection and Water Management, voivodship (county) funds for environmental protection and water management, and the Bank for Environmental Protection. The database collected initial information on about 450 projects; for 20 of them detailed studies were carried out consisting of a field inspection, interviews with persons involved in the implementation of projects and analysis of the projects operating conditions. Descriptions of four RES projects are given below. Each description contains information on the type of technology used, the rationale for undertaking the project, and data on the implementation costs and environmental benefits. At the end of this chapter we also include contact information for each project.

Projects were chosen for presentation that characterized the overall range of RES measures undertaken in Poland. They include, therefore, several types of technology — biomass boilers, landfill gas use, solar energy and heat pumps. The projects presented were those in which local governments were the investors, since, as the authors believe, in near term local governments will be the largest investors in small and medium energy systems where RES use is most appropriate. We evaluate these projects in terms of their economic cost and environmental benefits, and include a calculation of the ratio of implementation costs to net reduction in annual CO_2 emissions.

Case Study 1 The Use of Biomass in a Hospital Heating System[25]

PROJECT DESCRIPTION[26]

Wejherowo is a small, provincial town situated northwest of Gdansk, in Pomorskie Voivodship. The District Hospital situated there since 1980 operated its own coal-fired boiler-house, using three coal-fired steam boilers. The decision to replace the boilers was made in the second half of the 1990s. The decision was motivated by several factors: the wish to eliminate the frequent servicing and repairs required by the existing boilers; to reduce pollution and the disturbance caused by fuel deliveries and the removal of slag (a particular factor given the hospital's urban location); and the desire to reduce labor costs by eliminating stokers' jobs.

The decision was made to replace the old boilers with one fired by wood chips and two by oil in order to guarantee continuous heat supply. The 2.5-megawatt chip-fired boiler was expected to provide from 44 to 85 percent of heat energy required by the operation of the hospital. In addition, it was planned that the steam distribution unit, the steam installation and the heating regime in the hospital would be upgraded. The main factor which determined the choice of technology was the estimated availability of fuel. About 150,000 cubic meters of fuel wood are logged every year from forests near Gdansk. In addition, about 150,000 cubic meters of small wood pieces and waste wood from wood logging and dressing could be used for firing purposes. The calorific value of wood is usually about 2 megawatt hours per cubic meter, which means that 600,000 megawatt hours of energy from could be generated from woods in the area.

After the installation was put into operation, it turned out that the initial projections concerning the availability of waste wood had been too optimistic. In the heating season of 1999/2000, the biomass-fired boiler was not used according to the project's design specifications because of difficulties in purchasing wood chips — in 2000 the hospital managed to buy only 2,270 cubic meters while the boiler required 7,050 cubic meters per year to operate at full capacity. It was not able to solve this problem until the end of 2000 (it was expected that in the heating season of 2000/2001 the boiler would work at full capacity.) Thus, the long-term success of the investment project depended on ensuring adequate fuel supplies.

ECONOMIC ANALYSIS

Outlays for the implementation of the investment project (together with the energy audit of the hospital and technical documentation) were initially estimated at about PLN 5 million.[27] This total was made up of the following elements:

- energy audit and design and preliminary design costing documentation — 9 percent
- wood chip-firing boiler (delivery, assembly, start-up) — 48 percent;
- oil-fired boilers (delivery, assembly, start-up) — 31 percent;
- construction work and disassembly of three coal-fired boilers — 8 percent; and
- construction of the steam distribution unit and the steam network — 4 percent.

As the hospital planned to use a biomass-fired boiler, it was able to seek external funding for the project. Fifty percent of the cost was financed with grants from the Ecofund in Warsaw, which provided a grant amounting to 24 percent of the costs (i.e. PLN 1.2 million), and the Voivodship Fund for Environmental Protection and Water Management (which provided PLN 1.3 million). The hospital paid the remaining 50 percent.

Estimates indicated that the investment cost would be returned in about five years. However, the ultimate economic viability of the project depends greatly on price of the fuel source — the investment should be economically viable if the purchasing price of wood chips is under PLN 35 per megawatt hour and become more profitable the larger the share of woodchips used. In 1998 (i.e. the first year of operation following the modernization), the overall labor costs for the boiler-house were almost half those for the previous year when the old boilers were still in use.

ENVIRONMENTAL BENEFITS

The implementation of the investment project brought significant environmental benefits, primarily in the form of the reduction of carbon dioxide emissions, but also in respect of other pollutants, including sulfur dioxide and dust (see Table 3).

Case Study 2 The Use of Waste Wood for Energy Generation in Urban Conditions[28]

PROJECT DESCRIPTION

Otwock is a town of about 30,000 inhabitants on the northeastern outskirts of Warsaw. It has long enjoyed a reputation as a health resort. In the course of maintaining green areas in the town and on industrial sites, and while removing windbreaks, waste wood is collected, consisting mainly of the ligneous parts of woody plants. Usually in Poland such wood is dumped in municipal landfills, or it is burned outside or in traditional coal-fired boilers. The total production of collected wet waste wood in Otwock is estimated at 625 tons per year. This waste is a large renewable resource, with the potential to be used as fuel in modern dedicated boilers.

The Town Sanitation Company in Otwock wished to use the waste from the maintenance of town greenery for energy generation purposes to avoid landfill costs and environmental usage fees. These costs amounted to about PLN 80 per ton of collected and landfilled waste wood, while the environmental fee paid for using the company's old coke-fired boiler was about PLN 2000 per year.[29] Economic analysis indicated that replacing a coke-fired boiler with a biomass-fired boiler would be profitable.

The biomass-fired boiler was used to replace the worn coal-fired boiler in one of the town greenery maintenance units. A 150 kilowatt fluidized-bed boiler, firing wood chips, was chosen to heat the complex of greenhouses belonging to the Town Sanitation Company in Otwock. In periods of severe frost and the peak heat demand, the old boiler could be put into operation.

ECONOMIC ANALYSIS

The project implementation cost was about PLN 134,700, consisting of:

- buying a fluidized-bed boiler — 33.4 percent;
- buying a chopper and tractor — 44.5 percent;
- the construction of the biomass storage facility — 15.0 percent; and
- other equipment and materials — 7.1 percent.

The project was financed out of the Town Sanitation Company's own resources together with grants from the Department of Environmental Protection of the Town Office in Otwock and the Small Grants Program of the Global Environmental Facility (SGP/GEF). According to the user of the installation, the operation of the new boiler was economically viable (even when taking into account the depreciation of equipment obtained free of charge). The cost reduction consisted of the following items:

- savings from no longer needing to buy 60 tons of coke a year for old boiler — PLN 7,000 per year;
- savings from no longer disposing of 126 tons of wet waste at landfill — PLN 1000 per year; and
- cost saved in fees for the use of the environment — PLN 2,000 per year.

ENVIRONMENTAL BENEFITS

The environmental benefits included:

- avoiding the disposal of 126 tons of wet waste at a composting plant or at a landfill;
- avoiding the problems of the collection and disposal of waste from coke burning (slag); and
- reducing sulfur dioxide emissions by 1,000 tons per year, of carbon dioxide by 126,400 kilograms per year and allowing a major reduction in carbon monoxide and dust emissions.

Considering initial project outlays only, the cost per ton of annual reduction in CO_2 emissions was PLN 1,066.

Case Study 3 The Use of Landfill Gas for Energy Generation[30]

PROJECT DESCRIPTION

The most common manner of municipal waste disposal in Poland is deposit at landfills; only a small part of waste is disposed of in other ways. Municipal waste contains a substantial quantity of biodegradable components, as much as 50-70 percent, creating significant methane emissions.

The landfill at Gdansk — Szadolki, has been in operation since 1973. It is estimated that the total quantity of waste deposited there is about 8 million tons in an area of 56 hectares. Annually, the landfill accepts about 230,000 tons of municipal waste, including 140,000 tons of biodegradable waste, of which 70,000 tons is organic waste.

In 1995, the landfill gas was examined and found to contain 60 percent methane, and 21-30 percent carbon dioxide. Yearly emissions of methane were estimated at about 561,000 cubic meters. On the basis of this examination it was decided that the gas could be used to generate electric energy, thereby reducing emissions into the atmosphere. The project was also motivated by the need to eliminate explosions and fires caused by the decomposition of biodegradable waste at the landfill.

ECONOMIC ANALYSIS

The basic investment outlays were estimated at PLN 2.1 million, whereby 21.5 percent of the cost came from the investor's own funds; 13.5 percent from a grant from the Ecofund; 41 percent from a loan from Sweden; and 24 percent from a loan from the Voivodship Fund for Environmental Protection and Water Management in Gdansk.

An analysis carried out during the initial project-design stage indicated the following options for making use of the biomass energy produced:

- the production of electric energy to meet the investor's own needs, with the surplus sold;
- the production of electric energy and heat to meet the needs of a housing estate nearby; and
- the transfer of gas to the housing estate for on-site heat generation.

Owing to lack of interest on the part of potential users, the first option was selected: the gas was to be used to generate electric energy on the site of the landfill with the surplus power sold to the Energy Distribution Company.

ENVIRONMENTAL EFFECT

The project was projected to reduce emissions of methane by about 561,000 cubic meters per year (404 tons). This is equivalent to 10,000 tons per year of CO_2 in terms of impact on global warming (one ton of methane equating to 25 of CO_2). The combustion of this methane causes the release of about 1,100 tons per year of CO_2, yielding a net saving of 8,900 tons of CO_2 equivalent.

The project was estimated to generate 3,200 megawatt hours of electricity per year from methane combustion. If this amount of electricity were generated from coal 1,300 tons would be required, which would produce 2,800 tons of CO_2 per year. Combining this figure with the net CO_2 reduction from methane combustion yields a total emission reduction equivalent to 11,700 tons of CO_2 a year.

Considering initial project outlays only, the cost per ton of annual reduction in CO_2 emissions was PLN 179.

Case Study 4 The Use of Solar Energy and a Heat Pump in a School[31]

PROJECT DESCRIPTION

Blizne is a small town situated in southeastern Poland, 40 kilometers from the city of Rzeszow. In the past, the Blizne Primary School used an old, inefficient coal-fired boiler-house. A building program was proposed at the school involving the addition of a gymnasium and swimming pool, which was expected to increase heating demand. These plans stimulated the decision to modernize the boiler-house.

Projections for the school's operating costs after the expansion showed that heating costs would become the second largest cost item in the school budget. A heating systems company was contracted, which proposed removing the existing coal-fired boilers (with a total output of 500 kilowatts) and introducing a system consisting of solar panels, an oil and gas-fired boiler-house (430 kilowatts) and a heat pump for recovering the exhaust heat from the ventilation system of the swimming pool.

The part of the installation designed to capture solar energy consisted of 40 solar panels with the maximum power gained in summer of about 80 kilowatts, connected to two heat accumulators, each with a three cubic meter capacity. Heat from these accumulators could be used directly to provide hot tap water through a heat exchanger or to feed the central heating system (when using the heat pump). The heat balance of the site indicated that in the summer the solar installation should fully meet water-heating needs.

Another system to improve the energy efficiency of the building complex was the heat recovery unit, taking up heat from the ventilation system of the swimming pool and gymnasium. Heat is exchanged by means of a heat pump, which recovers almost 90 percent of the heat from the air outflow. The recovered energy is used to heat the air supplied to the rooms. In the winter, this mechanism reduces the energy needed to heat the two rooms by around 60 percent. The school building was also insulated to reduce heat losses.

ECONOMIC ANALYSIS

Initial estimates indicated that the investment cost would be about PLN 850,000, consisting of the following items:

- preparing technical documents — 0.9 percent;
- the construction of the mechanical ventilation system with heat recovery — 16.5 percent;
- heat insulation in buildings — 22.4 percent;
- buying and assembling the gas-fired boiler-house and adaptation of the room — 41.9 percent;
- the purchase and assembly of 40 solar panels — 9.7 percent;
- the purchase and assembly of the 90 kW heat pump — 5.2 percent; and
- system controls — 3.4 percent.

Owing to the longer period for preparing the documentation (to meet the sponsors' wishes), the actual implementation cost of the investment project was higher by about PLN 100,000.

The Gmina (community) authorities were able to finance only part of these expenditures, contributing about PLN 300,000 (representative of about 43 percent of its investment budget). However, their efforts mobilized external funding, including a PLN 408,000 grant from the National Fund for Environmental Protection and Water Management, a PLN 263,000 grant from the Ecofund and a PLN 25,000 loan from the Voivodship Fund for Environmental Protection.[32]

The project implementation allowed a reduction in the annual operating costs of the boiler-house. The major savings were due to the reduction of fuel, employment and repair costs — amounting to a total of PLN 400,000 in a year. The ordinary period of the return of the investment outlays is 19 years (with the internal rate of return equaling 1 percent). The grants received will make it possible to reduce this period to about 11 years.

ENVIRONMENTAL BENEFITS

Preliminary estimates indicate that the project reduced carbon dioxide emissions by about 590 tons per year (i.e. by 79 percent of previous emissions) and totally eliminated sulfur dioxide and dust emissions, which had previously totaled 3.34 and 5.02 tons per year, respectively. These emissions exceeded the limit values set out by the former Vovivodship Office in Krosno (SO_2 by a factor of 1,000 and dust by a factor of 10).

The project reduces the maximum heat demand for the whole building complex in the winter to 318 kilowatts. At the same time, despite the fact that the cubic space of the heated sites almost doubled and additional heating requirements emerged in connection with the operation of the swimming pool, the consumption of convention fuel energy fell from 1,817 to 835 megawatt hours, that is, by 55 percent.

Considering initial project outlays only, the cost per ton of annual reduction in CO_2 emissions was PLN 1,610.

Conclusions

The findings of this report indicate that effective climate protection policies in Poland include the use of renewable energy sources and enhancement of efficient energy use. Not only can they contribute to a substantial reduction in GHG emissions, they have the potential to offer additional benefits, such as other positive environmental impacts, the creation of new jobs, and ensuring sustainability. Therefore, particular support should be provided to their development.

A vital factor in supporting the development of RES and enhancement of energy efficiency in Poland is finance. The case studies carried out for this report indicate that most RES-using institutions obtained grants or preferential credits; the sources of this finance included different institutions such as Voivodship, Powiat or Gmina funds for environmental protection and water management, the Ecofund, and the Bank for Environmental Protection. The availability of finance was one of the principal factors stimulating these kinds of investment projects.

All the projects examined in case studies demonstrated high compliance with the above criteria. They met the requirements of UNFCCC and Polish environmental policy. They contributed to the sustainable and substantial reduction of GHG emissions, which could be demonstrated and verified. They all helped to achieve additional environmental benefits.

The projects also serve as good examples for other Gminas undertaking energy planning. However, some doubts emerge about the criterion of job creation (it was not found that new jobs would be created and current jobs always maintained). Moreover, given the lack of information, it was difficult to examine the emission reduction costs. However, the examples of countries with high RES potential, such as Germany or Denmark, indicate that these costs will decrease significantly when the measures of this type are applied on an industrial scale.

It is significant therefore that the government has begun to appreciate the potential benefits of developing RES and energy efficiency and has taken some supportive measures. Regarding energy efficiency, the important steps include the adoption of the Act on Supporting Thermo-Modernization Measures and the establishment of a special fund to provide financial support to projects of this type. Regarding RES, the most important instruments include the legislation obliging the Council of Ministers to integrate RES development into national energy policy and the legislation which allows the Minister of Economy to require electricity and heat buyers to purchase some of their needs from RES.

Nevertheless, the studies carried out by the Institute for Sustainable Development indicate that the development of RES has, to a great extent, depended on local and individual initiative. This finding shows that the current government policies need to be strengthened if there is to be a significant increase in RES use on a nation-wide scale.

Endnotes

1 *Environmental Protection 2000.* Main Statistical Office (GUS), Warsaw 2000 and the authors' own calculations.

2 The main public authority responsible for the implementation of the provisions of UNFCCC is the Ministry of the Environment. The subsidiary body, which was established in 1999, is the Climate Convention Implementation Office situated at the National Fund for Environmental Protection and Water Management (NEF).

3 Communication on the Implementation of the Tasks under the United Nations Framework Convention on Climate Change, Ministry of the Environment, 2000, typescript.

4 The Second National Communication to the Conference of the Parties of the United Nations Framework Convention on Climate Change. Warsaw, 1998.

5 It is notable that these policies have not been undertaken specifically to protect the climate. Their implementation has been motivated primarily to achieve a balanced budget and liquidate loss-making sectors of the economy, enhance national economic competitiveness, reduce resource waste and to prepare Poland for membership in the European Union.

6 E.g. the value of the GWP index (GWP — Global Warming Potential) is 25 for methane, which means that the reduction of emissions of this gas by 1 ton is as significant for climate protection as the reduction of CO_2 emissions by 25 tons.

7 In addition to the amount of cost, an important criterion is the availability of funds for the implementation of a given project. Therefore, the difficulty of ensuring full financial coverage and the cost of fundraising may be treated as additional elements of the evaluation of the different measures to protect the climate.

8 In conducting this evaluation the authors also drew on a number of publications, including: Hille E., "Energy Efficiency" In Selected Issues of Poland's Energy Policy, PEC, Warsaw, 1997; Wisniewski G., "Renewable Energy Sources" In Selected Issues of Poland's Energy Policy, PEC, Warsaw 1997; Weizsacker E.U., Lovins A.B., Lovins L.H. Factor four. PTWzKR & Wyd. Rolewski. Torun 1999, Carley M, Spapens P. Sharing the World, Institute for Sustainable Development. Warsaw-Bialystok, 2000. (in Polish)

9 The process of modernization of local boiler-houses is independent of that of the large grid-connected power plants, owing to the age of these boiler-houses and the need to improve the local energy supply systems.

10 The Guidelines for Poland's National Energy Policy is the most important long-term prediction of the demand for energy and an action program for the implementation of the national energy policy. It is prepared by the Council of Ministers and submitted to Parliament for approval.

11 Still, the discussion on the future of nuclear energy in Poland has not yet produced a clear decision. Despite the fact that Poland remains a country without nuclear power plants and the national energy policy does not provide for their construction, at least until 2020, there is a strong lobby supporting the development of this branch of the energy sector (although such plans meet with strong public opposition).

12 Official Journal of 1997, No. 54, Item 348.

13 E. Hille, J. Popczyk and W. Stodulski, *Privatisation of the Electric Power Generation sector in Poland and Sustainable Development.* Report 3/97. Institute for Sustainable Development; Warsaw 1997. (in Polish)

14 Official Journal of 1998, No. 162, Item 1121.

15 *The Report on the Functioning of the Act on Supporting Thermo-modernization Projects as of September 2000.* Minister of Regional Development and Construction, December 2000.

16 Ibid.

17 <www.senter.nl/erupt>

18 Personal information of Helmut Schreiber from the World Bank.

19 These views are questioned by the Polish Ecological Club (an NGO) estimates and experts who say that the technical and economic potential of renewable energy sources in Poland is substantial and able to meet 15-80 percent of the country's energy needs.

20 Karaczun Z., Kassenberg A. and Sobolewski M., *Poland and the Provisions of the Climate Convention.* Institute for Sustainable Development. Report 2/2000. Warsaw, 2000 (in Polish)

21 For these figures the base is currently 2.5 percent.

22 <www.mos.gov.pl/oze/dokumenty/safire.pdf>

23 G. Wisniewski, Analysis of the Possible Systemic Measures and Instruments to Support the Implementation of the Strategy on the Development of RES, Warsaw 2001, typescript.

24 As presented in the White Paper of the European Commission entitled Energy for the Future.

25 Sources of more information about this project:
F. Ceynowa Special Hospital; 10 Dr. A. Jagalskiego St; 84-200 Wejherowo. Tel: (48-58) 672 10 83; Fax (48-58) 677-0011
Mr. Miroslaw Klause, M.Sc. — Deputy Director for Operation and Administration of the Hospital; Tel: (48-58) 672-3995

26 All the installations featured here were identified and described in the framework of the project Local Action for Global Climate implemented by the Institute for Sustainable Development.

27 PLN 4= USD 1

28 Sources of more information about this project:
Deputy Director for Greenery; Town Office in Otwock; Mr. Ryszard Mysliwski; Tel/Fax: (48-22) 779-2614; Mobile phone: (0-604-421-885)

29 Emission charges for SO_2 have an effect on costs.

30 Sources of more information about this project:
Zaklad Utylizacyjny Spolka z o.o. (Waste Disposal Plant Co. Ltd.)
5 Reduta Zbik St; 80-761 Gdansk; Tel: (48-58) 301-2451; Fax (48-58) 300-0191; E-mail: zut@zut.com.pl; Mr. Jan Ruszkiewicz; Tel: (48-58) 303-9951; mobile phone: (0-601-651-923)

31 Sources of more information about this project:
Primary School and Gymnasium at Blizne
Mr. Jozef Nogaj, Director of Gymnasium; 36-221 Blizne
Tel: (48-13) 430-5279 or 430-5224

32 In addition, following the administrative reform, the Voivodship Fund supported the project with PLN 70,000.

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The National Communication to the First Conference of the Parties to the United Nations Framework Convention on Climate Change. Warsaw, 1994.

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Romania
Energy Sector Reform

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Introduction

AIM AND SCOPE

GHG emissions in Romania have continually decreased in the period 1990-2000, due mainly to the decline in economic output.[1] Nevertheless, energy consumption and GHG emission levels per unit of GDP remain significantly higher than the average for other industrialized countries, suggesting that the need and opportunity to undertake measures specifically aimed at GHG reduction is great. Romania has signed and ratified the major international treaties and conventions in the field of environmental protection, including the Kyoto Protocol. In order to satisfy the requirements of accession to the European Union, Romania has also developed several national strategies to promote sustainable development. However, agreed comprehensive and detailed medium and long-term strategies on reform of the energy sector — which is responsible for around one half of Romania's total CO_2 emissions[2] — do not currently exist. Developing such a plan of action requires an accurate understanding of the present constraints and opportunities for GHG reduction within this sector. This report is intended to contribute to this task by analyzing examples of how two energy providers are coping with the challenge of GHG emissions reduction.

The relevant general characteristics of the Romanian energy sector are described in this section, followed in the next section by the criteria used for assessing our case studies. The third section examines the performance of two combined heat and power plants. On the basis of this analysis we then offer general conclusions for the reform of the energy sector.

The sources of information used for this study comprise the following:

- examination of the available data in statistical reports, national and sector (energy and environment) strategies, energy companies' reports, NGO studies and others (see References);
- interviews carried out by the authors with representatives of ministries, energy companies, NGOs, universities and research institutes;
- questionnaires regarding the status of the measures applied for GHG emissions reduction, addressed to energy companies;
- meetings and consultations with members of the Romanian Energy Working Group;[3] and
- a workshop with other NGOs.

GENERAL CHARACTERISTICS OF THE ROMANIAN ENERGY SECTOR

The energy sector in Romania has been, and to a large extent still is, plagued by the specific problems faced by most countries in transition:

- low efficiency of energy production and usage;
- high marginal cost of energy production;
- poor legislative, institutional and regulatory infrastructure, plus administrative inefficiency leading to high transaction costs;
- increases in energy prices that consistently exceed the general rate of inflation;
- low collection rates especially from industrial users but also from individual consumers because of the high share of energy bills in total household expenditure; and

- poor record on energy conservation and compliance with national environmental requirements.

These problems have been exacerbated by the poor performance of the economy — particularly over the past few years — high inflation rates and the disappointing level of foreign direct and portfolio investment. The most important single incentive for meaningful reform has been external. Since the political changes of 1989, the Romanian energy sector has benefited from grants, loans and technical assistance programs from the international community. Major donors include political institutions such as the European Commission and various United Nations agencies, while loans have been arranged through the major international financial institutions, chiefly the European Bank for Reconstruction and Development (EBRD) and the World Bank. In addition to multilateral projects, several individual countries, notably Denmark, the Netherlands, France and the United States, are active in the energy and energy efficiency field in Romania with bilateral projects. A significant proportion of those resources has been directed towards improving energy efficiency, thus to reducing GHG emissions. Much of this assistance has been motivated by the need to prepare Romania for accession to the European Union.

Power generation, distribution and transport used to be a vertically integrated state monopoly and were controlled, after 1989, by the former Romanian Energy Authority RENEL "Regie Autonome,"[4] later restructured as the National Electricity Company S.A., Conel. In July 2000, the government decided to dismantle Conel. Four new companies have been established which act independently on a contractual basis as separate judicial entities. These are joint stock companies as follows:[5]

- Transelectrica, S.A.[6] — in charge of the transportation and dispatch of electricity through the national grid;
- Electrica, S.A. — in charge of electricity distribution and supply;
- Termoelectrica, S.A. — in charge of heat and electricity generation and of fuel supply and imports. It provides 40 percent of the national heat output, supplying both hot water for heating and domestic consumption and steam from combined heat and power plants and thermal plants; and
- Hidroelectrica, S.A. — hydroelectric generation.

There is also a category of independent power producers, currently numbering 10, but around 90 percent of national energy output is still produced by former Conel power facilities.[7] The Medium Term Strategy of the Government (2000) provides for the privatization of electricity and heat generation and distribution activities in the 2001-2004 period.

At the district level, over 400 Regii Autonome (RAs) were established after 1989. In 1994 a government ordinance limited the number of local RAs to 250, either through amalgamation or transformation into commercial companies. Most of the remaining local RAs are located in larger cities and have kept their status through loans from international financial institutions (European Bank for Investment, EBI or EBRD). In addition, more than 100 commercial local district heating companies have been established in smaller towns, including former local RAs.[8]

The high level of emissions from Romania's energy sector is in part a result of continued reliance on hard coal and lignite, which account for 62 percent of the sector's total emissions.[9] However, the level of emissions is further increased by the general inefficiency with which power and heat are generated. Problems include: lack of operating and investment capital (owing in part to payment arrears); use of obsolete equipment designed in the 1960s and 1970s without regard to environmental considerations; poor maintenance; and poor management. In short, there is an urgent need for both institutional reform and technical rehabilitation.

Evaluation Criteria

The criteria used for assessing our case studies consist of the following:

- Energy savings
- GHG emission reduction
- Economic benefits, including:
  - — costs per unit of energy produced; and
  - — rate of collection from consumers.
- Quality of Service
- Social benefits, including:
  - — transparency and communication;

— consumer satisfaction; and

— consumer education.

- Project sustainability/replication, including:

— increase in the number of consumers served; and

— replication of the project in other locations.

Ideally, an assessment of good practice should be based on data regarding all these points. In the cases we studied, however, such information was not always available or the relevant authorities were unwilling to supply it. Access to financial information, in particular, was often not granted. Several attempts to obtain more information related to economic performances of the cases were made, but data provided was scarce. Therefore, the assessments related to the economic criteria are based on the statements of plant managers.

Case Studies — Introduction

To evaluate current policies and measures within the Romanian energy sector, we have selected two providers of district heating. District heating systems, major suppliers of heat to Romania's urban population, are responsible for a significant share of GHG emissions and often unable to maintain adequate levels of service to residential consumers.

Sixty-one of Romania's larger towns have district heating systems, most of which are supplied by heat and power co-generation plants, are owned by the former Conel or by industry. In some towns district heating is provided by heat-only plants, owned by the former Conel, by municipalities or by industrial enterprises. Energy losses in district heating systems are high due to poor pipe insulation, corrosion and lack of maintenance. In buildings, the two main problems are: the lack of meters and controls; and poor insulation and sealing. For existing buildings, the standards for insulation and heat loss are below OECD levels. For the new buildings the standards comply with the European ones.

In a number of areas (including Bucharest and Constanta) the district heating system is chronically unable to meet peak demand (only 60 percent of the peak demand in these areas is met). In Bucharest, as in other major Romanian cities, the distribution system is operating at beyond the designed supply capacity because during the communist period the residential construction outpaced the installation of heating infrastructure. Domestic consumers situated at the end of the district heating network are the most disadvantaged and receive heat and hot water at low levels of quality. Moreover, because installations are inadequate to meet current service expectations, even consumers branched at the beginning of the network are not satisfied with the levels of heat and hot water delivered. During wintertime, the quality of heat supply is greatly impaired due mostly to discontinuities in fuel supply (owing, for instance, to low pressure in the natural gas network). In these circumstances domestic consumers are usually only supplied with heat during one period of the day, usually at night, and with hot water during a different period of the day, mostly in daytime.

Residents have to pay the costs of inefficiency not only in end-use, but also in production and distribution. Moreover, tariffs are related to the heated volume (floor area), instead of heat consumption. Therefore the tariffs are poorly adapted to providing incentives for end-use efficiency.

With these points in mind, the authors agreed that a comparison between attempts to increase efficiency within two combined heat and power (CHP)[10] plants of different sizes and under different types of ownership would provide insights regarding GHG mitigation measures in Romania.

The cases examine:

- NUONSIB, a small CHP plant in the town of Sibiu, run as a joint venture and supplying heat to grid consumers in apartment buildings.
- Bucuresti Sud, a large capacity CHP plant, owned by the state, which supplies heat to a Bucharest residential district and to local industry.

Case Study 1 NUONSIB Combined Heat and Power Plant

GENERAL INFORMATION

NUONSIB is a joint venture established in 1996 by the Dutch company NUON International (50 percent) and the City Council of Sibiu (50 percent).

Before the joint venture came into being, the plant was fully owned by the city council. It used to be a heat plant, burning natural gas and providing

TABLE 1

Energy production and fuel consumption — NUONSIB

Year	Heat production (Gcal)	Electricity production (kWh)	Gas consumption (m^3N)
1998	30,829	5,422,170	5,372,906
1999	25,684	5,914,370	4,545,550
2000	20,756	6,602,130	3,883,043
2001*	18,367	7,284,600	3,565,935

*estimate

Source: NUONSIB

TABLE 2

Trends in CO_2 emissions for NUONSIB

Year	Annual fuel consumption [m^3N][1]	Annual CO_2 emissions [kg][2]	Reduction of CO_2 emissions compared to the previous year [%]
1998	5,372,906	7,087,000	N/A
1999	4,545,550	5,995,800	15.4
2000	3,883,043	5,121,750	14.7
2001	3,565,935	4,703,550	8.1

1 "m^3N" denotes cubic meters of gas at normal pressure and temperature.

2 The calculation of CO_2 emissions reduction was based on data provided by NUONSIB regarding fuel consumption, heat input with fuel, overall efficiency and heat and electricity output. The data were then correlated with the EU standards on the emission factor for CO_2 corresponding to natural gas combustion. The CO_2 emission factor related to the energy output, and the overall CO_2 emissions per year were thus calculated.

heat and hot water for 24 blocks of flats (about 1,500 apartments), 20 companies, one high school and a kindergarten. The efficiency of heat production was approximately 80 percent.

The rehabilitation of the plant comprised two stages: the first stage, completed in 1997, raised the overall efficiency from 80 to 86 percent and the second, completed in 2000, raised efficiency to 90 percent. It was transformed into a cogeneration plant fired with natural gas with a nominal capacity of 15 gram-calorie per hour (Gcal/h) of heat and 950 kilowatts of electricity. The use of natural gas had the advantages of yielding a high conversion efficiency, having a low impact on the environment (NUONSIB is situated within the urban area of Sibiu) and local availability of supply (Sibiu itself is located close to the main domestic source of natural gas in the Transylvania Plateau). The electricity produced in cogeneration is sold to the Sibiu subsidiary of Electrica S.A. NUONSIB also owns and operates the district heating system. Technical assistance from NUON International for the start-up and further maintenance of the plant in the early years of operation provided the local staff with valuable experience.

PROJECT MEASURES

The efficiency of the plant was enhanced by:

- shifting from heating only to a co-generation system to improve efficiency and allow the electricity produced to be sold;
- replacing old boilers with more efficient ones;
- introducing plate heat exchangers to improve heat transfer and reduce gas consumption;
- improving the district heating network — 80 percent of the pipelines were pre-insulated and pro-

vided with signaling devices for early warning and localization of losses; leaks in the network were reduced by 80 percent; and

- training the company personnel to improve individual performance and personal responsibility.

The company plans to install meters in each apartment it services, leading to an estimated reduction of heat consumption and costs of 20 to 30 percent.

EVALUATION

Energy savings

The use of co-generation and higher performance equipment led to higher overall efficiency for the CHP plant.[11] It rose from a baseline of approximately 80 percent, when the plant produced only heat, to 90 percent in 2000. It is notable that NUONSIB was able to achieve a lower level of emissions per unit of energy produced than the $59x10^{-6}$ kilograms of CO_2 per kilojoule (kg CO_2/kJ) recorded for the gas-fired power plants of Termoelectrica.[12] The figures for NUONSIB were $58x10^{-6}$ kg CO_2/kJ following the first rehabilitation stage and $55.5x10^{-6}$ kg CO_2/kJ after the second rehabilitation stage. The figures are related to total energy output (heat and electricity). NUONSIB records data for the past years and its 2001 estimates indicate a sustained reduction in fuel consumption due to improvements of the plant's efficiency and to the reduced losses in the district heating system (see Table 1).

The quantity of thermal energy production decreased because of the rehabilitation of the district heating transport and distribution network, even though the level of service provision and number of consumers was maintained.

GHG emissions reduction

GHG emissions have not been measured at the plant because there are no specific regulations requiring measurements. However, the level of emissions can be easily calculated if the parameters of the plant's operation are known. A marked decrease in emissions, in direct proportion to the reduction in fuel combustion, is evident (see Table 2).

Economic benefits

According to the company's own estimates, the cost of the thermal energy generated and sold by NUONSIB is now the cheapest in Sibiu. According to plant managers, the company's ability to deliver high quality service at relatively little cost to the consumer led to fewer collection problems and improved the company's financial performance. NUONSIB now has a faster turnover and is not affected by arrears, a common problem among Romanian energy suppliers.

In the future, the reduction achieved in GHG emissions could open the way for further economic gains to the company from use of emissions trading once the required mechanisms are in place.

Quality of service

The supply of heat and hot water was uninterrupted and takes place at satisfactory norms according to consumers.

Social benefits

Improved transparency and communication has been a clear by-product of the project. The company has a direct interest in reducing network losses and encouraging rational heat consumption and has thus given much attention to educating consumers on energy conservation and the operations of the company by organising regular meetings and workshops.

The quality of the services and the low cost of the thermal energy supplied, together with regular meetings between the company and the consumers, met the expectations of end-users. Consumer satisfaction is also reflected in the high rate of timely payments.

The relatively small number of employees working at the plant (12) received proper training by international standards. Consequently, the performances, operational responsibility and job satisfaction of the personnel were also enhanced.

Project sustainability/replication

Extending the number of consumers. The installed capacity of NUONSIB is sufficient to allow the extension of service to other consumers in the town. According to plant managers, residents and companies from other parts of Sibiu are considering connection to the NUONSIB network.

TABLE 3

Fuel consumption CHP Plant Bucuresti Sud

Year	Natural gas consumed [1,000 m^3N]	Fuel oil consumed [1,000 kg]
1997	474,742	615,515
1998	535,508	439,598
1999	331,777	456,027
2000	371,893	359,695

TABLE 4

CO_2 emissions at CHP Plant Bucuresti Sud[1]

Year	CO_2 from gas [million tons]	CO_2 from fuel oil [million tons]	% CO_2 emissions from fuel oil	Total CO_2 [million tons]
1997	791	1,769	69.1	2,560
1998	892	1,263	58.6	2,155
1999	553	1,311	70.3	1,863
2000	620	1,034	62.5	1,653

1 Figures converted to tons and rounded to the nearest million to ease comparison.

New branches in other towns. On the strength of the improvements in profitability and customer satisfaction achieved by this joint venture, NUON is considering investing in power projects in other parts of Romania, such as the town of Tirgoviste.

Case Study 2 Bucuresti Sud CHP Plant

GENERAL INFORMATION

The Combined Heat and Power (CHP) Plant of Bucuresti Sud is a subsidiary of Termoelectrica, S.A. The plant provides electric and thermal energy (steam and hot water) for urban and industrial consumers in the neighboring area. The fuel used consists of natural gas and fuel oil.

The total available capacity of the plant is:

- 500 megawatts electric energy;
- 2,140 Gcal thermal energy;
- 860 Gcal/h base capacity; and
- 1280 Gcal/h peak capacity.

The equipment is rather old. It has a low level of performance (compared to similar Western equipment) and, like most of the existing energy production plants in Romania, the repairs and maintenance were inappropriately made. In the last five years, the overall efficiency was approximately 73-78 percent.

Like all energy production plants belonging to Termoelectrica, Bucuresti Sud CHP Plant has no autonomous juridical status; consequently, all transactions are carried out by Termoelectrica. Like most Romanian enterprises, Termoelectrica's operations are hampered by arrears, the existence of subsidies to consumers, including indirect subsidies to industry — which are soon to be cut, according to a recent declaration of the Romanian Prime Minister — and heating subsidies for domestic users.

Unlike the previous case, the district heating network is operated by a separate company, Radet. Therefore, there is no direct link between the energy (heat) supplier and the end-users. Moreover, the arrears on payments experienced by Radet (according to Radet managers), undermine its ability to pay Termoelectrica for energy supplies.

The subsidies given to energy consumers are more than offset by Radet's practice of compensating for distribution losses by increasing prices for consumers. Since few households are supplied with heat meters, consumers are unaware of the difference between the heat they pay for and the heat they actually consume. The high price of heat has led to (1) a significant number of domestic users (no specific data is available for the case itself) disconnecting themselves from the district heating network, which leads to severe technical problems for the operation of the network, and (2) the disconnection of residents' associations (in blocks of flats) from the network by Radet, owing to unpaid arrears.

PROJECT MEASURES

Under a project financed by the World Bank project rehabilitation and modernization, work is being carried out at two of the boilers with the objective of:

- extending operational life by 150,000 hours;
- achieving the original design parameters for output and efficiency/heat rate; and
- maintaining service at least 80 percent of the time.

Within a different project, at a third boiler a chemical agent has been added after the combustion process that considerably reduces the build up of salt deposits on the pipes. This measure has produced a 20 percent increase in overall efficiency. The work has been conducted by Energy-Serv, a private Romanian energy company, one of the few acting Energy Services Companies (ESCOs) operating in the country.

EVALUATION

Energy savings

Since 1997 the amount of fuel consumed has decreased markedly. However, this has been due mainly to decreased demand for heat as most of the industries supplied with heat by this plant were shut down, according to the plant managers. Overall efficiency remains rather low at 73-78 percent (for simultaneous production of heat and electricity), and no significant improvements can yet be noticed as a result of rehabilitation work underway.

GHG emissions reduction

The authors calculated the annual CO_2 total emissions using plant data on gas and oil consumption, and standard conversion factors for the quantity of emissions produced by combustion of each fuel type (see Table 4).

Over the 1997-2000 period, annual CO_2 emissions decreased constantly along with a reduction in fuel consumption. When the rehabilitation work is finished, an upgrading of the efficiency will probably be registered, resulting in an additional reduction in CO_2 emissions.

Fuel oil combustion accounted for the majority of total CO_2 emissions for all four years, in part because of the greater quantity consumed and in part because of its higher emission factor by comparison to natural gas. In addition, the oil used has a high sulfur content (3 percent, according to managers), leading to significant SO_2 emissions, as well.

Economic benefits

The rehabilitation works are still in progress; no data on their effect on the ratio of costs to output was available. It is assumed that when work is completed positive impacts on the energy costs and the financial performance of the plant will occur.

Quality of service

As our interviews revealed, the problems with service suffered by domestic consumers in Romania's large cities generally are also encountered by those supplied by Bucuresti Sud CHP Plant. These problems cannot be overcome unless the existing generation capacities and networks are expanded and rehabilitated in order to fully cover demand. So far, the measures being implemented have not achieved this effect.[16]

Social benefits

Transparency and communication are rather low at both the plant and Termoelectrica. Staff were generally slow or unwilling to provide the researchers of this report with data regarding the CHP plant's performance. This unwillingness is likely related to the plant's monopoly position, which reduces incentives to improve service delivery or to communicate with the public. One of the plant's managers declared, for instance: "The CHP (plant) can hardly be shut down because there are no other heat sources in the neighborhood to meet the demands!"

Project sustainability/replication

The World Bank project under which Bucuresti Sud CHP Plant's rehabilitation is being carried out also includes plans to work on two other Termoelectrica CHP plants. Termoelectrica did not supply data regarding these projects to the authors despite several requests. However, it was stated that implementation of the projects had been delayed.

The process used to reduce salt deposits on the pipes of one of Bucuresti Sud's boilers has also been used successfully at Iasi CHP Plant.

Conclusions

The two case studies cannot easily be compared because of the substantial differences in factors such as ownership, size, capacity and number of consumers served. While NUONSIB CHP Plant is a small, semi-private company, supplying district heating to a small number of consumers, CHP Plant Bucuresti Sud is a large, state-owned plant that supplies heat mainly to large residential areas, as well as steam to a number of industries. However, application of the assessment criteria outlined above allows some general observations to be made concerning the performance of the plants and the institutional models they represent.

GHG emissions have been progressively reduced in both cases over the period considered. At NUONSIB CHP Plant this reduction was clearly achieved as a result of improved performance. At Bucuresti Sud, however, the available data do not establish whether the rehabilitation works carried out over this period contributed significantly to GHG reduction. The plant has lost an important share of its consumers and, given that the overall efficiency of CHP Plant Bucuresti Sud is 73-78 percent for the period analysed, it appears likely that the reductions achieved were due mainly to this decline in demand.

NUONSIB's smaller size may have improved manageability. The limited number of personnel employed by small plants allows for easier training.

NUONSIB shows more transparency and openness in its decision-making process and is more forthcoming in its relationships with other stakeholders. This pattern contrasts with that observable at Bucuresti Sud and Termoelectrica, suggesting that monopoly status creates resistance to change.

The measures taken at NUONSIB appear to be sustainable and likely to be replicated elsewhere. However, not enough data was available to assess the sustainability of the measures at Bucuresti Sud.

In short, it appears that smaller scale, autonomous energy producers are better able to achieve sustainable and reproducible gains in energy efficiency, GHG reduction and service delivery. At present, the bulk of Romania's energy sector has not been reformed along these lines. Accelerating the restructuring of the energy sector is imperative, therefore, if Romania is to fulfill the goals set by the National Sustainable Development Strategy and to comply with the standards required for accession to the European Union.

Endnotes

1 In 1989-99 a 55.7 percent decrease of CO_2 emissions coming from Termoelectrica, S.A. power and heat plants was recorded, owing mainly to the decline in industrial consumption (Termoelectrica, S.A. is a state energy utility company, which owns the majority of Romanian power and heat plants that use fossil fuel).

2 The contribution of the energy sector to the total GHG emissions is as follows: 48.6 percent for CO_2, 14.4 percent for CH_4, 60 percent for N_2O and 52 percent for CO (National Commission for Statistics).

3 The present form of the report also takes into consideration the observations and comments made by readers on different occasions (e.g. the REC workshop on April 2-4, 2001, "TERRA Millennium III" energy and environment workshop on April 20-21, 2001, and other meetings with specialists and NGOs organized in Romania in the period April-May 2001).

4 Regie autonoma (RA) is a state utility operator (e.g., energy, water supply and others), acting as a monopoly.

5 Nuclear activities have been placed under the co-ordination of Nuclearolectrica, S.A. and the National "Regie" for Nuclear Activities. Both are under the authority of the Ministry for Industries and Resources.

6 S.A. is the Romanian abbreviation for "societate pe actiuni", that is, joint stock company.

7 Conel reports and ANRE (National Agency for Energy Regulation).

8 The bulk of Bucharest's heat is distributed by Radet – the district heating company of Bucharest – a publicly owned company under the authority of Bucharest Municipality.

9 1998-1999 Annual Report of Termoelectrica, S.A.

10 Combined heat and power plants are common within Romania's energy sector.

11 The overall efficiency of an energy production plant is defined as the ratio of energy produced (in the case of a CHP, heat and power) to fuel energy consumed.

12 According to the Methodology for Quick Evaluation of SO_2, NO_x, dust and CO_2 Emissions from Thermal Power Plants, PE – 1001/1994.

16 For technical reasons, the slump in industrial demand has not created surplus heat supply for residential users since industry and residential supplies require different types of generating equipment

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Slovenia
The Carbon Dioxide Tax and Investment in Co-generation Plants

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Introduction

Slovenia was the second CEE government (after Poland) to sign Annex A of the Kyoto Protocol and one of the first European countries to introduce a CO_2 tax. In this report we focus on the actual and potential impact of this tax on the installment of combined heat and power (CHP) plants. Specifically, we consider the impact of the CO_2 tax on the economic viability of CHP and the influence of the tax on their introduction during the period 1997-2000.

The following section reviews advantages of CHP as a means of generating energy in a cost-effective and environmentally friendly manner. The introduction of the CO_2 tax in 1997 is then described, as well as its initial design and subsequent amendment. An assessment of the projected impact of the CO_2 tax on the economics of CHP is then presented. This section also considers briefly the broader economic and fiscal context for CHP, including energy prices and pricing policy, the introduction of Value Added Tax (VAT), and market access and prices for power sold by CHP companies. We then describe the relevance to CHP of the plans to restructure the energy sector along market lines contained in the 1999 Energy Law. Results are then presented of empirical research conducted by the authors to assess the influence of the tax on the investments in new CHP capacity that took place from 1997-2000. This section is based on responses to a questionnaire sent to all the operators of new CHP capacities installed between 1997 and 2000 and on in-depth interviews made with operators of the four largest CHP units installed in this period. The final section presents our conclusions, finding that CHP installation can be regarded as a "good practice" for climate change mitigation, but that the CO_2 tax has so far played little role in stimulating investment in this area.

The Environmental and Economic Advantages of CHP

Co-generation (combined generation of heat and electricity — CHP) is the most thermodynamically efficient method of energy production.[1] When modern thermal energy plants were first developed, co-generation was the most common method used, but since then its share of total capacity has decreased significantly, both worldwide and in Slovenia itself. Today, its share of total energy generation in Slovenia is only 8 percent.[2]

Recent years, however, have seen a marked revival in the use of co-generation, and increased concerns regarding the impact of power generation on the environment and climate change.[3] Tomsic (1999, p. 151) argues that in Slovenia CHP should be treated as the single most important measure for improving the economic viability of local energy systems and for reducing CO_2 emissions at the national level. The National Strategy and Short-Term Action Plan for Reduction of GHG adopted by the Slovenian government in November 2000 also identifies increased use of CHP and district heating systems as among the most important measures for reduction of CO_2 in Slovenia. In 1995 a Phare study on energy conservation potential in Slovenia assessed the economically viable potential for industrial and municipal co-generation at 600 megawatts.

Today, natural gas is generally much cheaper to transport over long distances on land than coal or electricity. The development of highly efficient[4] and cost-competitive CHP technologies yielding various ratios of power to thermal energy has made CHP an economically competitive option for meeting both industrial and residential heat needs. Since the transport of heat/steam is economically viable only over much shorter distances than that of electricity, the existence of sufficient local demand for heat is the

TABLE 1

Heat production costs for different fuels and users

COST PARAMETER		*COMBUSTION FOR HEAT PRODUCTION*		
		*General consumption**	*District heating*	*Industry*
Exemption from CO_2 tax		0%	50%	67%
FUEL: LIGHT FUEL OIL				
Caloric value	kWh/l	10.01		
Units of pollution (CO_2)	PU/l	2.60		
Excise tax	EUR/l	0.025	0.025	0.025
CO_2 tax	EUR/l	0.039	0.020	0.013
Net purchase cost	EUR/l	0.145		
Final cost	EUR/l	0.209	0.189	0.182
Final cost of energy	EUR/kWh	0.021	0.019	0.018
Share of CO_2 tax in final cost		18.7%	10.3%	7.1%
Heat cost from boiler**	EUR/kWh	0.024	0.022	0.021
FUEL: NATURAL GAS				
Caloric value (at standardised m^3)	kWh/Sm^3	9.47		
Units of pollution (CO_2)	UP/Sm^3	1.90		
Excise tax	EUR/Sm^3	0.00	0.00	0.00
CO_2 tax***	EUR/Sm^3	0.020	0.010	0.007
Net purchase cost 3,500 h/year	EUR/Sm^3	0.143		
Final cost	EUR/Sm^3	0.162	0.152	0.149
Final cost of energy in fuel	EUR/kWh	0.017	0.016	0.016
Share of CO_2 tax in final cost		12.3%	6.5%	4.4%
Heat cost from boiler**	EUR/kWh	0.020	0.019	0.018
NATURAL GAS EXTENDED CONSUMPTION				
Net purchasing cost	EUR/Sm^3	0.100		
Final cost	EUR/Sm^3	0.120	0.110	0.107
Final cost of energy in fuel	EUR/kWh	0.013	0.012	0.011
Share of CO_2 tax in final cost		16.6%	9.1%	6.2%
Heat cost from boiler**	EUR/kWh	0.015	0.014	0.014

Source: Tomsic M., Merse S (1999): *Vpliv takse na emisije CO_2 na donosnost soproizvodnje elektricne in toplotne energije,* in: *Komunalna energetika* – Power Engineering, Proceedings B, Maribor: Univerza

* VAT is not included. Fuel or heat costs will be increased by 19 percent for users liable to VAT.

** Heat costs from boilers are calculated assuming 90 percent efficiency and operation costs of SIT 0.20 per kWh; depreciation of boiler is not included.

*** Includes the 30 percent reduction in CO_2 tax granted natural gas.

**** Costs for CHP are presented at the level of input fuel, since total costs are shared by heat and electricity produced.

key limiting factor in determining the cost-effectiveness of CHP.[5] Nevertheless, the relative price of electricity produced by local CHP units compared to that available from the national grid also has an important impact on CHP's economic attractiveness.

The CO_2 Tax

HISTORY AND BASIC PROVISIONS

The Slovenian government's Decree on Tax on Emissions of Carbon Dioxide came into force on January 1, 1997. The decree was based on the principles embodied in the 1993 Law on Environmental Protection and its provisions related to the introduction of pollution charges. This decree helped pave the way for the CO_2 decree of 1998.[6] Initially the tax per kilogram of CO_2 was set at one Slovene tolar (SIT), or approximately EUR 5.5, per ton of CO_2. A table defining emissions for quantities of fuel consumed was attached to the Decree.

The CO_2 tax was significantly revised in 1998. In March of that year the government issued a decree tripling the tax to SIT 3 per kilogram. This increase provoked strong protests from affected industries. The Chamber of Industry argued publicly that the Decree would have a negative impact on economic performance, and even threaten the survival of a considerable number of enterprises. After extensive consultations with industry and energy experts, the government made some revisions to the Decree, which came into force on October 1, 1998.[7]

The present tax rate — approximately EUR 15 per ton of CO_2 — is in practice reduced by a number of exemptions. The basic exemptions[8] are:

- 0.44 UP/kWh[9] of electricity produced (excluding that consumed by the unit itself);
- 67 percent of the fuel consumed for the generation of heat in industry;
- 50 percent of the fuel consumed for the generation of heat for district heating systems;

These exemptions mean that existing power plants have not paid any tax to date.

Unlike many economic instruments which foster responses based on expectations of future effects such as cost increases the response to the CO_2 tax will be delayed for several reasons:

- Time is needed for the relevant decision-makers to understand how the tax will affect their operations. In practice in Slovenia, this process has typically taken up to one year.
- One response to the tax will be the switching of fuels, which in many cases involves capital investments that take time to implement.
- Actors may be unsure as to whether the tax and its provisions will remain in place.[10] Certainty can only be built over time.
- In the case of the 1998 CO_2 tax decree in Slovenia, there is a further reason why a delay of at least one year in the tax impacting decision-making may be expected: the tax exemptions may be used over the period of one year. Because the tax was introduced in late 1998, industry felt the full impact of the tax only in 1999, and in some cases not until 2000.

These factors have certainly reduced the impact of the CO_2 tax on CHP investments since its adoption. They may also have negative consequences in the longer term if appropriate compensatory measures are not adopted.

Projected Impact of the CO_2 Tax and Other Fiscal Instruments

In this section we analyze the projected impact of the CO_2 tax in combination with the other tax reforms recently introduced by the government relevant to the energy sector: in particular, VAT and excise duties.

On July 1, 1999, the Law on Value Added Tax and the Law on Excise Duties came into effect. These taxes have a significant impact on electricity prices. Before this, natural gas was taxed at 5 percent and electricity at 10 percent. Under the VAT law all energy carriers are taxed at 19 percent, representing a substantial price increase for consumers. The level of excise duty, however, varies substantially for different fuel types, altering their relative competitiveness. Oil has become more competitive by comparison to natural gas, while all electricity producers are exempted from paying excise tax on fuel consumed. Since most of the changes were publicized well ahead of their

TABLE 2

Shares of CO_2 tax exemption for industrial CHP technologies using various fuel types

Technology	*Generation efficiency*			*Ratio of heat to electricity*	*Total fuel consumption for electricity generation [kWh_f/kWh_{el}]*	*Share of fuel exempt from CO_2 tax by fuel type*				
	electricity (h_{el})	***thermal (h_{th})***	***total (h_{tot})***			***Natural gas***	***LPG***	***Diesel oil***	***Heavy diesel oil***	***Brown coal***
Piston engine	38%	47%	85%	1.24	2.63	160%	147%	104%		
Gas turbine	30%	55%	85%	1.83	3.33	140%	130%	96%		
Steam turbine	18%	60%	78%	3.33	5.56	111%	105%	85%	83%	76%
Combined cycle	42%	43%	85%	1.02	2.38	170%	155%	108%		

Source: Tomsic M., Merse S (1999): *Vpliv takse na emisije CO_2 na donosnost soproizvodnje elektricne in toplotne energije,* in: *Komunalna energetika* – Power Engineering, Proceedings B, Maribor: Univerza

TABLE 3

Technological characteristics of a sample CHP plant

Investments	*EUR/kW_{el}*	*825*
Electrical efficiency		38%
Thermal efficiency		47%
Heat to electricity ratio		124%
Technical lifetime	years	15
Fixed operation costs – % of investments		3%
Fixed operation costs	EUR/kWyear	24.7
Maintenance – variable costs	EUR/MWh	10
CO_2 tax exemption for el. production*	EUR/MWh	6.6

Source: Tomsic M., Merse S (1999): Vpliv takse na emisije CO_2 na donosnost soproizvodnje elektriāne in toplotne energije, in: Komunalna energetika – Power Engineering, Proceedings B, Maribor: Univerza

* 0.44 PU/kWh and EUR 15 per PU

implementation, we take them into account as part of the framework for decision making regarding CHP investments.

COMPARISON OF HEAT COSTS

In assessing CHP's economic competitiveness, one relevant comparison to undertake is with the cost of separate production of heat. Table 1 presents calculations of heat production costs made by Merse and Tomsic[11] in 1999 (VAT is not included because it is refunded for the enterprises considered). [12]

With regard to natural gas, it is necessary to take into account the tariff system, which reflects the ratio between fixed costs (around 40% of total costs) and the costs of purchasing additional quantities of natural gas (i.e., variable costs, about 60% of the total).

Fifty percent of the fuel consumed by district heating providers and 67 percent of that consumed by industry is exempted from the CO_2 tax. These exemptions have been incorporated into the calculations. Because the exemption quantity is defined by the reference year and is not influenced by current consumption, the actual average exemption for exist-

TABLE 4

Comparison of economics of CHP fueled by natural gas

ECONOMIC PARAMETER		INDUSTRY: REPLACING ELECTRICITY BOUGHT FROM GRID				PUBLIC SERVICE: SELLING ELECTRICITY			
		With CO_2 tax exemptions		*Without exemptions*		*With CO_2 tax exemptions*		*Without exemptions*	
Operation mode		***Seasonal***	***Extended***	***Seasonal***	***Extended***	***Seasonal***	***Extended***	***Seasonal***	***Extended***
Operation	h/year	3,500	2,000	3,500	2,000	3,500	2,000	3,500	2,000
Fuel costs* (per kWh el.)	EUR/MWh	36.25	24.44	45.16	33.34	36.84	25.02	45.16	33.34
Electricity value	EUR/MWh	60.48	56.49	60.48	56.49	64.19	72.70	64.19	72.70
Value of heat	EUR/MWh	18.50	13.51	20.07	15.08	18.90	13.91	20.07	15.08
Heat utilisation share		100%	100%	100%	100%	100%	0%	100%	0%
Net revenue of operation	EUR/MWh_{el}	37.11	38.76	30.14	31.80	40.72	37.68	33.85	29.36
Total operation time	h/year	3,500	5,500	3,500	5,500	3,500	5,500	3,500	5,500
Annual net revenues	EUR/MW	106,123	183,649	81,751	145,351	118,771	194,122	94,723	153,434
Payback time	years	9.0	5.17	11.6	6.5	8.0	4.9	10.0	6.2
Internal rate of return	%	7.8%	19.6%	3.6%	14.0%	9.9%	21.1%	5.9%	15.2%

Source: Tomsic M., Merse S (1999): *Vpliv takse na emisije CO_2 na donosnost soproizvodnje elektricne in toplotne energije,* in: *Komunalna energetika* – Power Engineering, Proceedings B, Maribor: Univerza

* Exemption for electricity produced (0.44 PU/kWh) and quantity exemptions (67% in industry and 50% in public district heating service) for fuels used for heat production are included in fuel costs.

ing units may be different. The share of CO_2 tax in the fuel price for heat generation units varies from 4 percent to 19 percent. One must also take into consideration the fact that additional tax exemptions could be granted to co-generation plants.

Effective costs with taxes, however, depend on the type of consumer and the efficiency of generation. In the last column, the costs of electricity production with the full rate of CO_2 tax taken into account is given as input data for additional calculations.

ESTIMATION OF THE ECONOMICS OF CO-GENERATION UNDER THE REVISED CO_2 TAX REGIME

As mentioned above, the 1998 revisions to the CO_2 tax decree introduced a number of exemptions that affect the economic viability of CHP generation. The most important parameter for calculating the effective tax exemption is electricity efficiency (cel), defined as the ratio of generated electricity to energy value of the fuel consumed in the generation process. Table 2 gives the share of CO_2 tax exemption for selected types of co-generation units. The figures take into account the general tax exemption of 67 percent of fuel for production of heat in industry as well as the additional exemption for generation of electricity.

An exemption of more than 100 percent creates the opportunity for increased (but tax exempted) production at the unit itself, or at another unit owned by the same company, in order, for example, to meet peak demand. The tax deduction permits are not, however, tradable. The level of tax exemption assumed is that applicable to district heating systems, which can apply only for 50 percent of the quantity of fuel used for generating heat to be exempted, and which can exceed 100 percent only if the fuel used is natural gas.

Table 3 presents calculations for the performance of a hypothetical CHP plant using a gas or diesel internal combustion engine with an output from 1-10 MWe and an electricity generating efficiency of 38 percent, presuming low-voltage connection to the grid and little need for infrastructural investment. (A gas turbine would perform similarly.)[13]

Tables 4 and 5 analyze the impact of the CO_2 tax on the economics of co-generation fueled by natural gas and extra-light oil (diesel) respectively.[14] The

TABLE 5

Comparison of economics of CHP fueled by diesel

ECONOMIC PARAMETER		INDUSTRY: REPLACING ELECTRICITY BOUGHT FROM GRID				PUBLIC SERVICE: SELLING ELECTRICITY			
		With CO_2 tax exemptions		*Without exemptions*		*With CO_2 tax exemptions*		*Without exemptions*	
Operation mode		***Seasonal***	***Extended***	***Seasonal***	***Extended***	***Seasonal***	***Extended***	***Seasonal***	***Extended***
Operation	h/year	3,500	2,000	3,500	2,000	3,500	2,000	3,500	2,000
Fuel costs* (per kWh el.)	EUR/MWh	37.39	37.39	48.25	48.25	38.47	38.47	48.25	48.25
Electricity value	EUR/MWh	60.48	56.49	60.48	56.49	64.19	72.70	64.19	72.70
Value of heat	EUR/MWh	21.25	21.25	24.15	24.15	21.98	21.98	24.15	24.15
Heat utilisation share		100%	100%	100%	100%	100%	0%	100%	0%
Net revenue of operation	EUR/MWh_{el}	39.37	35.38	32.10	28.11	42.91	24.23	35.81	14.45
Total operation time	h/year	3,500	5,500	3,500	5,500	3,500	5,500	3,500	5,500
Annual net revenues	EUR/MW	114,051	184,819	88,600	144,824	126,426	174,888	101,571	130,476
Payback time	Year	8.3	5.14	10.7	6.6	7.5	5.4	9.4	7.3
Internal rate of return	%	9.1%	19.7%	4.8%	13.9%	11.1%	18.3%	7.1%	11.7%

Source: Tomsic M., Merse S (1999): *Vpliv takse na emisije CO_2 na donosnost soproizvodnje elektricne in toplotne energije,* in: *Komunalna energetika* – Power Engineering, Proceedings B, Maribor: Univerza

Note: see note for previous table

analysis uses the data displayed in the previous tables. The effect of the new CO_2 tax mechanism with quantitative exemptions is compared to the effect it would have without exemptions, at a flat rate of EUR 15 per kilogram of CO_2.

Assuming quantitative CO_2 tax exemptions, the internal rate of return for units fueled by gas is between 19.6 percent and 21.1 percent, yielding a simple payback period of five years.[15] The corresponding values for diesel are 18.3 percent to 19.7 percent, with a payback period of 5.1 to 5.4 years. Without exemptions CHP becomes less profitable, with internal rates of return between 14-15 percent and payback of more than six years for gas and 12-14 percent (payback 6.6 and 7.3 years) for diesel oil.

This comparison means the exemptions granted after July 1, 1999 raise the internal rate of return for CHP by approximately 6 percentage points.

The estimate also found that CHP's economic viability with regard to supplying seasonal heat demand (i.e., 3,500 hours per year) is rather poor (IRR between 8 and 11%, simple payback more than eight years) relative to the 15-20 percent rate of return usually expected in industrial investments.

CONCLUSIONS

Along with VAT and excise taxes, the revised 1998 CO_2 emissions tax will have an important effect on the economics of CHP. The exemptions granted increased the rate of return by some 6 percentage points, shortening the payback period of an average CHP unit by one year, while at the same time not giving any advantages for new less efficient (compared to CHP) generation of heat or electricity. But the competitiveness of CHP will be greatly affected by future electricity prices, which will be determined by market-oriented reforms in the energy sector.[16]

The 1999 Energy Law

GENERAL PROVISIONS

Slovenia has taken the first step toward bringing its energy sector into line with the requirements of the EU accession process by introducing the Law on Energy of October 1999. Under the Law, two-thirds of the electricity market is to be opened to first domestic and then EU competition.

TABLE 6

Profile of the companies studied

Company	*Installed CHP capacity (kW_e)*	*Ownership*	*Main activity/product*	*Purpose of electricity and heat generation*
Energetika LJ.	6640	Municipal	Distribution of heat and gas	Sale (heat), own use (el.)
Zdravilisce Lasko (thermal bath)	250	Private	Tourist and medicine services	Own use
Jata d.d.	922	Private	Poultry	Own use
Energetika Ravne	3 x 2766	Municipal-private	Distribution of heat to metal industry	Sale and own use (heat), own use (el.)
ELAN d.d.	770	Private	Sport equipment	Own use
Kolektor Idrija	180	Private	Industrial equipment	Own use

Source: Data obtained by questionnaire

TABLE 7

CO_2 emissions savings achieved by CHP units

COMPANY	PRODUCTION			CONSUMPTION	CO2 EMISSIONS		
	Electricity (kWh/y)	Heat (kWh/y)	Efficiency of electricity generation	Natural gas (CHP unit) (kWh/y)	Emitted (t CO2/y)	SAVINGS 1* (t CO2/y)	SAVINGS 2** (t CO2/y)
Energetika LJ	45,830,000	64,648,000	30%	153,123,956	30,733	6,599	34,097
Zdravilisce Lasko	875,000	1,452,500	34%	2,543,605	511	251	776
Jata D.D.	3,434,000	3,762,000	38%	9,036,842	1,814	742	2,803
Energetika Ravne	37,758,390	26,038,000	41%	91,824,878	18,430	6,256	28,911
ELAN d.d.	4,956,430	6,443,359	39%	12,708,795	2,551	1,364	4,338
TOTAL	92,853,820	102,343,859		269,238,076	54,037	15,213	70,925

Source: Data obtained by questionnaire

* Savings 1: by comparison to average specific CO_2 emissions rates of electricity generation in Slovenia, i.e. 0.5 kilogram CO_2/kWh_{el}

** Savings 2: by comparison to specific CO_2 emissions rates from coal thermal power plants, i.e., 1.1 kilogramCO_2kWh_{el} [23]

Since April 15, 2001 all producers have been able to sell their electricity on the national market. For new plants, authorization to sell electricity is required. All final consumers with connection capacity of more than 41 kilowatts and all distribution companies are eligible to buy on the open market. The remaining "captive customers" (mainly households) are serviced by distribution companies under a public service regime.

The market will be opened for imports on January 1, 2003 under the Law's reciprocity clause. Since Slovenia is a net exporter of electricity, the electricity companies' wish to sell directly to a broad base of eligible customers abroad may well have been the main factor motivating acceptance of the wide market opening required by the Law.

The gas market will be liberalized at a slower pace. All electricity producers, including auto-producers, will be eligible consumers for natural gas from January 1, 2003.

It will be possible for providers of public transmission and distribution services to negotiate terms of access to the gas network.

PROVISIONS WITH A DIRECT IMPACT ON CO-GENERATION

Co-generation and small hydropower interests have lobbied for, and generally succeeded in introducing, favorable clauses into the Law for "qualified production" (QP), that is production of electricity with high efficiency, such as CHP, or from renewables. The market operator will have the responsibility of purchasing electricity from QP at no less than current market prices. The real meaning of this will be clarified when the regulations on market operation are issued.[17] (Although this was supposed to have been done within 12 months of the Law coming into force, at the time of writing — 18 months after the Law's introduction — these regulations have still not been issued.)

Two further clauses of the Law favor small CHP and renewable production. Firstly, qualified producers under 1 megawatt will be allowed to sell the electricity produced to all consumers, including those under 41 kilowatts. The household market will be open to them also, which is likely to offer higher prices.

A second provision limits network-access costs for small QPs. It reads: "The price for use of transmission and distribution systems for electricity produced by qualified producers of up to 1 MW nominal power may not include cost elements in excess of the costs that are minimal for provision of these services." This appears to rule out the inclusion of stranded cost elements — such as those for transmission (apart from those incurred in the supply of local consumers) — in network access charges. As different estimates and allocations of the system costs are possible, the regulatory office may choose a favorable estimate of the system costs for local producers should the favorable attitude towards CHP and renewables continue to prevail.

In addition there are provisions in the Law for the introduction of "green electricity" certification and quotas for resellers (distributors). There is no obligation regarding when and how much this instrument is to be used.

CONCLUSIONS

The Energy Law of 1999 creates the basis for a new legal framework that balances market forces and state intervention in the interests of improving energy efficiency and supporting efficient and/or renewables-based generation such as CHP. However, no one can make a final judgment of the impact of the legal framework on a specific means of generating electricity until exact regulations and technical rules are determined. Given the state's weak capacity, the uncertainties related to EU accession and the Kyoto process, and the accumulated social and political power of large-scale electricity generators and transmitters, the road to stable and favorable conditions for selling electricity from CHP seems likely to be long and bumpy. Since this process is far from complete, it would be premature to make firm conclusions regarding the implications of the regime that will ultimately emerge for CHP.

Case Studies

Since the CO_2 tax in Slovenia came into force in 1997, six new CHP units have been installed, with a total capacity of 17.1 MWe, representing 0.75 percent of national electricity generation capacity and approximately 15 percent of generation capacity in industry (120 MW_e). [18]

In January 2001 we issued a questionnaire to the energy and general managers of these plants, seeking information on the technology used and its performance,[19] and on the factors which had influenced their decision to use CHP. We inquired about how the companies had been informed of the introduction of the revisions to the CO_2 tax[20] and what influence subjecting the energy sector to market forces had had on their general decision making. Five of the companies responded. We also conducted telephone interviews with the directors of these companies and the energy manager of the company Jata D.O.O.

PROFILE OF THE COMPANIES

Table 6 gives information regarding the companies' ownership status, installed CHP capacities and main business activities. None of the six companies had previously used CHP. Previously they had relied on separate heat and steam production.

Perhaps the most significant difference between the companies in question is the share of energy costs in their total costs. The main purpose of energy production at Energetika Ljubljana and Energetika Ravne is to provide energy to local consumers; at these companies energy costs constitute over half of total costs. In the other companies, which generate heat and electricity only for their own use, the share of energy costs is less then 10 percent — in most of the cases less then 5 percent. Energetika LJ and

Ravne also have far larger installed capacities than the others, accounting for more than two-thirds of the six companies' total.

THE IMPACT OF THE CO_2 TAX ON DECISION-MAKING

We expected that the CO_2 tax would have been a greater influence on decision-making in the two larger companies. However, in their responses to the questionnaire, neither the larger nor the smaller companies identified the CO_2 tax as an influence on decision-making. However, the larger companies did differ from the smaller in taking forthcoming changes in the regulation of the energy sector into account, confirming our hypothesis that larger companies would take a broader range of factors into account in making decisions.

Nevertheless, in the case of Energetika Ravne, a follow-up interview with the director found evidence that the CO_2 tax played some role in determining the type of technology to be installed.[21] The company had indeed made a revision of their original technology choice because of the 1998 changes in the design of the tax.[22]

In both "energy" companies, the planning process for the CHP plants installed after 1997 began before the CO_2 tax was imposed in 1997 and still further predated the CHP-friendly adjustments made to the tax in late-1998. Our informants stated that if they had known of the revised version of the CO_2 tax they would have taken it into account when they decided which type of CHP technology to use.

KEY FACTORS INFLUENCING THE INSTALLATION OF CHP UNITS

According to the questionnaire, the key factors for installation of CHP units were, in all cases:

- the need to replace obsolete equipment, inferior in efficiency and production costs, to the best technology now available;
- the high price of (peak load) electricity from the public grid;
- the wish to reduce general production costs.

Additional factors included the desire to ensure reliable and high quality energy supply and to reduce negative impacts on the local environment. Although the respondents expressed concern with the environmental reputation of their company, the specific issue of climate change did not appear to be a consideration.

Despite differences among the companies in question, the CO_2 tax has not played any role in investment decision-making, except in the case of Energetika Ravne. Nevertheless, all companies reported that the installation of the new units had led to reductions in CO_2 emissions.

EMISSION REDUCTIONS ACHIEVED BY NEW CHP UNITS

Table 7 presents operational data for CHP units from our survey, which we used to calculate the CO_2 emissions savings achieved. Emitted CO_2 from combined production was compared with previous CO_2 emissions, using two different measures of indirect CO_2 emissions produced by electricity purchased from the grid:

- Average specific CO_2 emission rates for electricity generation in Slovenia: i.e., 0.5 kg CO_2/kWh_{el} (see "Savings 1" column in Table 7).
- Slovenian coal thermal power plants' specific CO_2 emission rates for electricity generation: i.e., 1.1 kg CO_2/kWh_{el} (see "Savings 2" in Table 7).

The emissions reduction attributable to separate electricity production is significantly higher than that from separate heat production. For this reason, the overall emissions savings relative to average specific electricity production emissions in Slovenia (0.5 kg CO_2/kWh) is given in column SAVINGS 1. However, the savings are almost five-times higher if the emissions rate of coal thermal power plants in Slovenia of 1.1 kg CO_2/kWh is taken as the reference point (See Table 7).

The comparison is relevant since in Slovenia coal thermal power plants are the most problematic units in terms of environmental impact and production costs. Furthermore, during the period in which these CHP capacities were installed, the modernization of thermal coal plants was the main policy option being considered by the government, despite the likely environmental and economic costs of this option.[24]

Conclusions and Recommendations

Our case-study data indicates that the installation of CHP capacities can be categorized as good practice for the reduction of GHG emissions because:

- a considerable reduction of CO_2 emissions has been achieved; and
- investment decisions have been market driven and taken by people attuned to market demands.

On the assumption that a more precisely defined framework for the electricity market comes into being which implements the basic principles of the new Energy Law of 1999, and that electricity prices become more predictable, further investment in new small capacity (i.e., under 1 MW(e)) CHP plants can be expected. Thus the cases are, in principle, reproducible on a wide scale.

Under the terms of its initial introduction in 1997, the CO_2 tax had little impact on either the economics of CHP or on investment decisions. In principle, the exemptions within the CO_2 tax mechanism introduced in late 1998 should, together with the replacement of sales tax by VAT and excise duties, significantly improve the economic attractiveness of CHP. The exemptions stimulated by the CO_2 tax decree have improved the rate of return on CHP by approximately 6 percentage points and reduced the simple payback period by about one year. However, the case studies find little evidence that the tax directly influenced the decisions analysed in our investigation, since they were made before the revisions of 1998.

The absence of new decisions to invest in CHP in the period from 1999 is explained by the uncertainties of the period: in particular, the continuing lack of the secondary legislation and accumulation of administrative and legal practice necessary to make clear the implications of the new Energy Law, and the rapid rise in oil and gas prices.

Based on this analysis, we make the following recommendations:

1. The CO_2 tax's positive impacts on both the environment and the economy could be strengthened if it were treated as a central instrument within a general program of green budget reform. If taxation on labor and transactions of capital were decreased correspondingly, the CO_2 tax, and other potential green taxes would meet less opposition from industry and trade unions.
2. While adjusting CO_2 tax to EU rules (on state subsidies), the tax should also be harmonized with the legal and constitutional order of the Republic of Slovenia; or additional support for the tax in the Environmental Protection Act should be provided.
3. Part of the CO_2 tax revenue should be earmarked for projects directly related to the reduction of GHG emission — whether within the country or abroad — in the form of financing for the development and introduction of energy conservation projects and renewable energy technologies.
4. More sensitive communication building with the public and different stakeholders regarding the CO_2 tax's rationale and its place within budgetary and environmental policy should be conducted.
5. Any further changes in the CO_2 tax should balance the need to build continuity against the need to strengthen the impact of the tax and streamline its administration.
6. Changes should be prepared by both industry and NGOs (including both professional organisations and environmentalists). It is equally important that the consequences of future changes are publicized well ahead of time, giving time for industry to adapt, and for other policies to be developed that harmonize with the changes proposed.

Endnotes

1 See: EU Council Resolution of December 18, 1997 on a Community strategy to promote combined heat and power, Official Journal C004, 08/01/1998, 1-2, 1998, see also: Tomsic and Merse 1999, p.59, and Tomsic 1999, p. 151

2 Tomsic and Merse, 1999, p. 60.

3 Compared to generation of electricity in an average conventional coal fired power plant, a modern natural-gas-based CHP unit produces 75 percent fewer emissions of CO_2 per unit of electricity generated (Tomsic, 1999, p. 151/152)

4 The efficiency ratio of modern gas turbines nowadays exceeds 36 percent, or 50 percent taking into account the combined gas-steam cycle. Modern internal combustion efficiency can achieve electrical efficiency of more than 40 percent, which is a very good result taking into account the (small) size and low price for the units. See: Tomsic and Merse, 1999.

5 According to Tomsic (1999), without state or municipal subsidies, new district heating networks in Slovenia will not generally be sufficiently profitable to attract private investment even in 2010, when much higher prices for electricity are to be expected.

6 We agree with Markovic and Schlegelmilch that the 1996 CO_2 tax was mainly meant to provide additional revenue. Its environmental implications may have been helpful in easing its passage through the legislature. (See: Markovic and Schlegelmilch, 1999, p. 326)

7 Despite these important changes, the CO_2 tax has not functioned as an instrument of green budget reform but primarily as a source of budget revenues. The absence of earmarked budget spending for the reduction of GHG, decreasing levels of support for energy efficiency and renewable energy and the lack of compensatory decreases of other fiscal burdens support this interpretation.

8 New and small power plants can justify exemption from the CO_2 tax on electrical generation on the basis that electricity from large (coal-fired) plants is in practice tax-free because large generating companies can (and do) demand tax exemption for 92 percent of their 1990-level emissions. The level of exemption for new power plants and co-generation units is based on a comparison with the best available new large units – large natural-gas-fired power plants with an efficiency ratio of 50 percent. The level of exemption of 0.44 UP/kWh for power plants feeding the public grid is approximately in accordance with the average emission output of electricity generation in Slovenia, about 0.50 UP/kWh at the level of distribution grid.

9 UP=A unit of pollution, i.e., one kilogram of CO_2.

10 This problem stems from uncertainties about the price of electricity following the restructuring of the domestic sector in April of 2001. These uncertainties have been exacerbated by the prospect of the opening of about two-thirds of the domestic market to EU suppliers set for April 2003. Many believe (probably incorrectly) that liberalization will lead to a fall in energy prices, which has led to the postponing of decisions regarding investment in new generation capacity. In addition, the energy regime is being destabilized by the lack of regulation regarding purchase of electricity from independent power producers and delays in general regulations on access to the grid, the price of system services, the allocation and design of compensation of stranded investment costs in the electricity sector, etc. Finally, EU accession means that the CO_2 tax mechanism will have to be re-designed to harmonise with EU regulations on industrial aid and subsides.

11 Merse and Tomsic: 1999, p.57-67.

12 The calculation was based on the assumption of a crude oil price of USD 15 per barrel on world markets, which was USD 3-5 over the actual price of that time. Since then, oil prices have risen to around USD 25-35. However, the comparative values remain valid.

13 Merse and Tomsic: 1999.

14 The cases given under “with exemptions” present estimations of expected real economics of CHP units while the “without exemptions” cases serve as a comparison.

15 Assuming 5,500 hours per year of operation time. In practice this level is rarely reached.

16 Due to the lack of reliable predictions of fuel and electricity prices in a liberalized energy sector and because of undefined terms of sales to the electricity grid, we can’t make micro-economic comparisons between investment in CHP and investment in other options (improved technology, installation of steam/heat boilers etc.). Although we assume that the individual companies in question have made a comparison of the IRR between different options, access to the data has been denied.

17 It may mean that “qualified production” will sell at the market-clearing price, whereas other market participants will conclude contracts at the price they offer.

18 Source: IEA, 1996; Cogen Europe, 1999.

19 In particular, we inquired about the type and power of engine, ratio between power and heat generation; electricity, heat and total efficiency rate; temperature regime; operation hours, annual production of heat and electricity.

20 The mass media and the Official Gazette of RS were mentioned as the only sources of information. We assume that additional channels information were available for publicizing the redesigned tax of 1998 (such as the Chamber of Industry, Slovenian E-Forum) but our questionnaire proved to be weak in providing more detailed answers.

21 Interview with Mrs. Mojca Kert Kos – the director of the company – on February 26, 2001.

22 Due to the changes in tax in the autumn of 1998 the economics of technology options had to be recalculated.

23 In both cases 90 percent conversion efficiency was assumed when estimating emissions caused by previous, separate heat generation.

24 On January 6, 1999, a nation-wide referendum was held on whether the state should issue financial guarantees for construction of a new 200 megawatt coal-fired power plant in Trbovlje to replace the old 120 megawatt unit. The proposal was rejected by a large majority of those who voted (one third of those eligible).

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Conclusions and Recommendations

ELENA PETKOVA

The case studies in this report provide information and insights to support two very different sets of conclusions and recommendations. First, their findings support conclusions about instruments, policies and projects CEE governments can take to promote cost-effective, socially and politically attractive GHG emission reductions. These conclusions can help CEE countries prioritize and target their limited resources to such policies and measures that best meet their national objectives and circumstances. Second, the application of common criteria by the authors, though not fully consistent across case studies, suggests some methodological conclusions about the relevance and value of criteria. This section is therefore divided in two so as to reflect these different sets of conclusions.

Selecting policies and measures

At first glance, it might appear that the countries of the CEE region have little need or incentive to implement targeted policies and measures for GHG emissions reduction. Basic fuel switching and the slump in industrial output since the end of socialism have greatly reduced overall emission levels in the region. Similarly, economic restructuring measures have reduced energy use and carbon intensity in the fast-reforming national economies.

There are at least three reasons, however, why CEE countries should not rely only on macro-economic reforms to meet their commitments under the Kyoto Protocol. First, in the faster-growing CEE economies, absolute emission levels are rising: Slovenia has already surpassed its commitment level, while a number of other economies are rapidly approaching their respective national targets. Second, absolute emissions from some sectors, such as transport, are increasing as is their share in the overall GHG emissions of the CEE countries. Thus, the structure and the relative importance of emission sources is changing with a larger share of the emissions coming from transport and the residential sectors. Third, while price and trade liberalization and privatization may be sufficient to stimulate switching to cleaner conventional fuel sources by energy generators and efficiency gains in private industry, they do not necessarily lead to greater efficiency and lower GHG intensity in the public and residential sectors. Nor do they encourage the development of the renewable energy technologies that in the longer term are likely to provide the greatest potential for sustainable emissions cuts.

Another reason for considering targeted measures and instruments for GHG emission reduction in CEE is associated with participation in the flexible mechanisms of the Kyoto Protocol. The national economies of the CEE countries are both energy and GHG emission intensive. Much energy is wasted, which amounts to wasting money. Policies and measures that reduce GHG emissions today (i.e., in the near term) save not only energy resources (and thus increasing disposable income of consumers and business) but also may free up emissions allowances from the Kyoto Protocol that can be sold to generate revenues. These funds can be reinvested to accelerate beneficial environmental and other outcomes, which may in turn make international emissions obligations easier to meet.

Therefore, CEE countries need to initiate and implement targeted GHG emission reduction policies and measures now to capture specific opportunities or curb negative trends in specific sectors.

Relatively small amounts of government spending through earmarked instruments — such as the earmarked energy efficiency funds in Hungary or soft financing for renewables in Poland — are capturing emission reduction opportunities through small projects in the residential sector, in district heating and in local utilities. For instance, the mean level of per project financing is approximately USD 115,000 by the Energy Saving Credit Fund (ESCF) and USD 70,000 by the Energy Saving Credit Programs in

Hungary, while the total costs for the renewable projects presented in the Polish case study range between approximately USD 33,000 and USD 1.2 million.

The case studies from Hungary and Poland suggest that soft loan mechanisms earmarked to support GHG emission reductions through small projects in energy efficiency and renewables can achieve three objectives. First, they can catalyze additional financing such as local grants and financing, foreign credit and grants from the Global Environmental Facility. Second, they can capture emission reduction opportunities unlikely to be realized through macro-economic reform such as energy efficiency in public buildings or installation of currently non-competitive small renewable projects. Third, they can achieve significant emissions reductions by financing and facilitating numerous projects. In Hungary, where the funds have had more extensive experience, their contribution is 4 percent of the overall GHG emission reductions over the last 10 years.

These experiences suggest that countries of the CEE region should implement financing mechanisms to support small projects that are environmentally, socially and politically desirable but would otherwise not be financially viable.

The case studies in this report indicate that different measures are associated with the different environmental outcomes, relative overall costs, social outcomes, cost effectiveness and cost of GHG emission reductions. And while the data from the different case studies is difficult to compare, in the near term end-use energy efficiency seems to be a desirable and cost-effective measure in terms of both GHG emission reduction and positive social and general environmental outcomes. The costs per ton of CO_2 equivalent reduced will vary from country to country depending on multiple variables, yet the cost of USD 5.80 to USD 17.50 per ton of CO_2 equivalent in the Bulgarian case study could be somewhat indicative of the GHG emission reduction costs in demand-side energy efficiency measures.

The case studies for Poland, Hungary, Romania, Bulgaria, and Slovenia indicate that local governments and district heating companies have a strong interest in implementing projects in energy efficiency, CHP and renewables. Increased energy prices may induce individual consumers (for instance, in Romania) to not pay their energy bills, which may aggravate the already heavy financial burdens on public institutions and authorities. However, experience in Poland, Hungary and Bulgaria presented in this report indicates that to respond to these incentives, local public institutions (such as municipal governments, schools and hospitals) must possess sufficient fiscal and decision-making autonomy, as well as access to preferential financing.

In principle, economic instruments aimed at internalizing environmental costs have strong potential to encourage GHG emission reduction measures (as argued by the transport case study in the Czech Republic). However, as the Czech case study concluded, practical policies to promote environmental cost-internalization still remain in infancy at both national and European Union levels. Until such policies develop, promising initiatives such as biodiesel production and the use of combined transport will require public subsidies if they are to remain viable. Regarding putting economic instruments into practice, the Slovenian case study found that the recently introduced CO_2 tax has so far failed to stimulate investment in emissions-saving CHP capacity. This probably stems from the delayed effect that tax policy has on decision-making and from general uncertainty about a rapidly shifting policy and economic environment. The study suggests that if they are to have a positive impact on decision-making, fiscal instruments must take into account wider economic and institutional conditions (such as price liberalization) as well as be adequately publicized and consistently applied over time.

The national case studies identify a further factor in implementing climate change mitigation measures: institution building is needed to ensure that successful projects are sustainable and replicated. The Bulgarian report, for instance, showed how the establishment of an association of municipal governments that was dedicated to improve energy efficiency could play a vital role in scaling up successful local pilot projects. Still, such institutional development usually requires initial external grant support and consistent effort over time. Its success depends on such macroeconomic policies as fiscal decentralization, availability of soft and creative financing and ultimately, over the long term, the general conditions and risks of commercial financing of small public projects.

A final conclusion that may be drawn from these studies is that projects and measures with a positive impact on GHG emissions have also been found to provide a wide range of benefits that CEE decision-makers and citizens perhaps may find more immediately relevant. For instance, reduced CO_2 emissions correlate closely with reductions in other forms of air pollution. Improved energy efficiency and CHP decrease costs for consumers while maintaining or even improving levels of service. In addition, small-scale investments in end-use and supply can create jobs, as well as enhance local decision-making capacity. It follows, therefore, that by actively implementing policies and measures to reduce GHG emissions, CEE countries can simultaneously improve public welfare in economic, social and other domains as well.

Selecting evaluation methods

The second set of conclusions and recommendations from the case studies is methodological and answers questions such as: why the evaluation criteria are useful; how they should be applied; and what the lessons are from the current application to the six case studies. The application of the criteria to selected policies and measures in the six CEE countries suggests a number of general methodological findings:

- A common set of criteria can be applied to diverse GHG emission reduction policies, measures and projects. If consistently applied, this allows comparisons among these very different measures, implemented at different scales. By allowing such comparisons, and should they be used, criteria and factors facilitate prioritization among diverse measures. They underpin decisions on earmarking resources to achieve specific goals, which might range from cost-effective GHG reductions to market, social or political objectives such as the development of a competitive renewables market or the creation of jobs.
- Quantitative data about individual projects or instruments is relatively easy to find and to calculate, though inconsistent measurement methodologies may narrow how the data can be applied. For instance, although every study includes data for CO_2 emissions reductions, only the Bulgarian and Polish studies also provide data about reductions of other pollutants, such as SO_2, NO_x and particulates. As a result, this information allows conclusions to be drawn about additional environmental benefits from municipal energy efficiency and renewables. Some quantitative data, however, are not available or difficult to estimate. These include data to measure such factors for instance as job creation or cost reduction for disadvantaged groups.
- Qualitative factors for criteria measurement are much more difficult to apply. In the CEE context, nonetheless, such qualitative criteria and factors such as institutional development, institutionalization and conditions for replication often determine whether GHG emission reduction measures will be implemented on a large scale. For instance, in Bulgaria a single demonstration project — accompanied by a significant investment in information dissemination, capacity building and networking — has strengthened some institutions and laid the groundwork to replicate the energy efficiency project in residential buildings in at least 25 towns. Qualitative information however is not always readily available and is more difficult to assess.
- The criteria can be better applied to specific projects and initiatives than to macro-economic policies. The six case studies are a first attempt to empirically apply the criteria, and at this stage no effort has been made to compare the pros and cons of different projects and measures. When applied consistently, however, the criteria can reveal the pros and cons of one project type versus another. Such information can enhance decision-making on climate change mitigation activities.
- Though in most case studies the criteria are applied to specific projects, their findings support conclusions about the macro-economic policies which support or obstruct project implementation or scaling up.

The criteria and the factors for assessing policies and measures were designed to meet the three principles defined by the Convention for policies and measures: reducing GHG emissions, promoting sustainable development and corresponding to national circumstances. In this sense, the criteria were developed from a CEE perspective and, more narrowly, only from the perspective of those CEE countries that aspire to join the European Union. Many of these criteria, however, might be relevant to other countries as well. For instance, reduction of costs for consumers, job creation or project financial sustainability are likely to be important considerations for any country considering climate change mitigation policies and measures.