An Economic Analysis of Poland's Opportunities to Mitigate Climate Change: The Role of Flexibility Mechanisms

By Sławomir Pasierb, Meredydd Evans, Ewaryst Hille, Stanisław Szukalski, and Ilya Popov[1]

Abstract
Poland has reduced its greenhouse gas emissions since the late 1980s because of structural reforms and economic decline. Poland still has numerous opportunities to cost-effectively reduce emissions through energy efficiency and renewable energy. As a result, Poland has a potential opportunity to sell excess emission allowances under the Kyoto Protocol and can benefit economically from these sales. This article examines the potential impact emission trading could have on Poland. It also discusses the policy options for using revenue from emission trading and promoting further carbon mitigation. It describes the impact and policy options both from a national perspective, and from the point of view of several sectors of particular importance. The article is based on a series of nine studies conducted by the Polish Foundation for Energy Efficiency and the Pacific Northwest National Laboratory and funded by the U.S. Environmental Protection Agency.

These studies found that emission trading could stimulate significant economic growth in Poland by reinvesting revenue from emission trading. Emission trading could also help reduce unemployment. Moreover, the assessment found that unemployment in the coal and agriculture sectors--two sectors of special concern--could be reduced by carefully targeting investment of emission trading revenue. Investing the potential revenue in climate-friendly business opportunities would reduce carbon dioxide emissions compared to the business as usual projections. In the climate-investment scenarios, economic growth would notably be above the government's projections, yet below that possible if emission trading revenue were invested in high-growth sectors. Finally, the analysis indicates that the Polish government can increase carbon mitigation and economic growth if it uses innovative mechanisms for re-investing emission trading revenue, rather than disbursing the funds as subsidies or grants.

Introduction

Poland's greenhouse gas (GHG) emissions dropped significantly in the 1990s because of economic restructuring and decline. Poland emitted 433 million tons of carbon dioxide in 1988, its baseline year under the United Nations' Framework Convention on Climate Change. The Polish Government estimates that the country will emit 396 million tons in 2012, which is below both Poland's 1988 baseline and the 6% reductions it agreed to under the Kyoto Protocol.

The Kyoto Protocol requires most industrialized countries, including Poland, to limit their GHG emissions compared to those in their baseline year. The Kyoto Protocol also allows countries that take on emission reduction commitments (listed in Annex B of the Protocol) to engage in the so-called flexible mechanisms. Emission trading and joint implementation are two of these mechanisms. Under emission trading, an Annex B country agrees to sell part of its international emission allocation to another Annex B country. Joint implementation also involves two Annex B countries, but the emission credit transfer is driven by emission reductions from a specific project, such as energy efficiency in a set of buildings or a renewable energy plant.

There are still numerous, profitable opportunities to reduce emissions in Poland at lower costs than for comparable projects in Western Europe and the United States. Poland, thus, has a potential opportunity to sell its excess emission allowances internationally and stands to gain much from these sales.

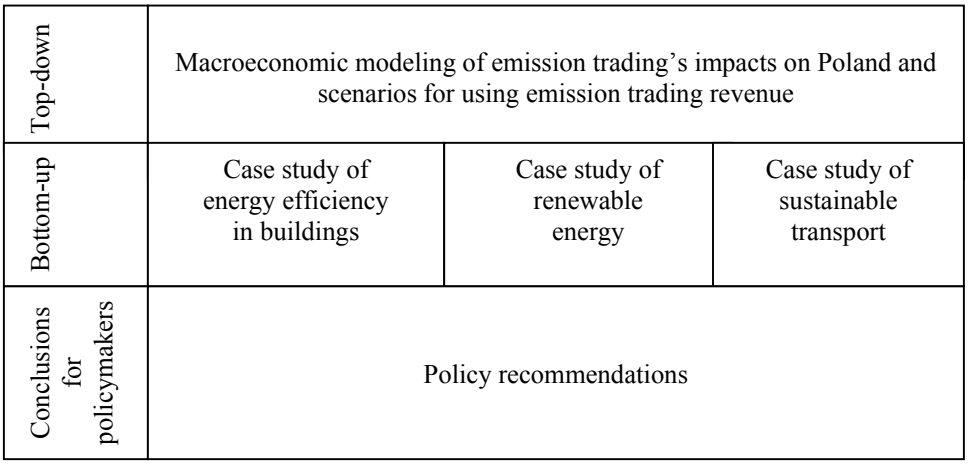
The Pacific Northwest National Laboratory (PNNL) and the Polish Foundation for Energy Efficiency (FEWE) launched a project in the spring of 2000 to assess the impact and benefits of emission trading on the Polish economy.

---

[1] Sławomir Pasierb and Stanisław Szukalski work at The Polish Foundation for Energy Efficiency (FEWE) in Katowice and Warsaw, Poland. Meredydd Evans and Ilya Popov are at the Pacific Northwest National Laboratory (PNNL) in Washington, D.C. Ewaryst Hille is director of E5, a private consulting company in Warsaw. PNNL was responsible for managing and designing the overall project and prepared this summary document. FEWE prepared the core studies on which this assessment is based.

The U.S. Environmental Protection Agency provided funding for this project under a cooperative agreement with the U.S. Department of Energy. Figure 1 depicts the structure and components of the assessment.

Figure 1. Structure of the Economic Assessment of Emission Trading in Poland



This article summarizes the methodologies and main findings of this economic assessment. It is based on nine reports that FEWE has prepared in Polish. A complete list of these reports may be found in the appendix.

Key Results of the Project

This assessment was designed to provide the Polish government with relevant, timely information regarding the impact of emission trading on the Polish economy and the environment. The project team consulted with the Polish government on numerous occasions both to obtain data for the assessment and to ensure that the final results would meet the government's needs. The main result of the assessment, thus, was providing the government with detailed information on the potential benefits and impacts of international GHG emission trading on Poland. Such information could then help the government in crafting its climate and energy policies.

In addition, the Polish government has undertaken or is considering other specific policy changes worthy of note:

1. In September 2000, the Polish government officially accepted a new target for renewable energy, taking into account the results of the economic research on renewable energy conducted under this study. According to the new target, renewable energy should meet 7.5% of Poland's energy needs by 2010; the old target had been 5%.
2. The Interministerial Commission for Coal Industry Restructuring is seriously considering changing its policy of providing coal miners with a one-time subsidy for resigning from their jobs. These subsidy payments have proven ineffective at creating new jobs and economic opportunities in the coal-mining region of Upper Silesia. This research shows that more concentrated funding for new business development, particularly in energy efficiency services, would be a more economically effective way of dispersing the remaining coal restructuring funds as well as a portion of the potential funds from emission trading. New energy efficiency businesses could also reduce unemployment in Upper Silesia by providing long-term opportunities for former coal miners in energy efficiency retrofits to buildings

The following pages describe the assessment in more depth. While this article is drawn from all nine studies conducted as part of the assessment, it focuses primarily on those covering the top-down economic assessment and the case studies in renewable energy and energy efficiency in buildings.

Assessing Emission Trading in Poland: The Top-Down Perspective

FEWE conducted a top-down economic assessment using two Polish macroeconomic models, one called the Dynamic Stimulation Model of the National Economy (DSM-NE), developed by FEWE, and the other called the

Polish Computable General Equilibrium Model (CGM), developed by the University of Warsaw with technical assistance funds from the European Union (EU). FEWE also relied on several other Polish and Western economic models, such as the Energy and Power Evaluation Program (ENPEP). ENPEP provides details on energy supply and demand. It is a general equilibrium model maintained by the Argonne National Laboratory. DSM-NE allows researchers to simulate changes in gross domestic product depending on the assumed rate of change in investment in the economy as a whole and in different sectors. This model was designed to assess the impact of demand-side management programs and carbon mitigation measures. CGM simulates the optimal allocation of limited economic resources and takes into consideration certain types of air pollution by assigning them economic costs. This model has been used to assess sulfur dioxide emission trading as well as the impact of carbon mitigation.

In the macro-economic assessment, FEWE assessed the following seven scenarios:

1. A reference case using emission projections from a recent Ministry of Economy study that analyzed Poland's energy strategy until 2020. This scenario does not consider flexible mechanisms.

   The reference scenario takes into account on-going structural changes and European integration strategies. It assumes that additional restructuring will be necessary in the coal, steel and other heavy industry sectors. The study and this scenario project gross domestic product growth of approximately 4% per year. The scenario also assumes that energy demand will begin to grow slightly after 2003. Natural gas will play an increasingly important role in primary energy supply, and electricity use will increase as a share of final energy demand.

2. Three scenarios, each with a different possible price for carbon and a different volume of assigned amount units (AAUs) available for sale. The scenarios assume that the government would use the money for the most economically efficient investments. (In other words, the government did not have an explicit policy of using the money for further carbon mitigation.) The sub-scenarios' assumptions are summarized in Table 1.

   Table 1. Assumptions used in Subscenarios 2a, 2b and 2c

Subscenario	AAUs available for sale (millions per year)	Average AAU price	Revenue from emission trading (millions per year)	Annual Reinvestment (millions) [2]
2.a	35	$10	$350	$200
2.b	45-50	$12-13	$600	$350
2.c	55-60	$14-15	$800-900	$700

   FEWE reviewed the literature on potential carbon prices to develop the range of likely carbon prices for the model; this range is $7-15.[3] FEWE also calculated the number of AAUs available for sale under each scenario by subtracting the projected Polish emissions from Poland's annual emission allowance under the Kyoto Protocol.

3. Three scenarios that assess policies for spending the revenue from emission trading. In this scenario, FEWE assumed conservatively that the price of carbon would only be $7 per ton. The revenue could be reinvested in carbon mitigation through:

   a. Direct subsidies,
   b. Interest-free loans, or
   c. Loan guarantees.

Table 2 describes growth in various economic sectors under scenarios 2a, 2b, and 2c; this table was derived from statistical data on past economic growth by sector and government projections of growth in capital investment for

[2] Denotes investment in economic sectors that provide the greatest return.
[3] These price estimates were prepared before the United States announced its intent to withdraw from the Kyoto Protocol.

the economy as a whole. Table 3 summarizes the modeling results and describes the changes in macroeconomic indicators and CO_2 emissions under each scenario.

Table 2. Estimated annual growth of specific sectors under Scenarios 2a, 2b, and 2c

Sector	2005			2010			2013		
	2a	2b	2c	2a	2b	2c	2a	2b	2c
Construction	0.07%	0.28%	0.38%	0.13%	0.18%	0.31%	0.13%	0.21%	0.21%
Energy	0.09%	0.84%	0.92%	1.35%	1.54%	1.66%	2.27%	1.89%	0.31%
Coal	0.11%	-8.01%	-7.90%	-4.94%	-5.22%	-4.91%	-7.61%	-8.76%	0.04%
Agriculture	-0.01%	-0.21%	-0.11%	-0.05%	-0.02%	0.11%	-0.13%	-0.15%	0.19%
Services	0.04%	0.17%	0.29%	0.12%	0.18%	0.31%	0.13%	0.20%	0.22%

Table 3. Annual changes in macroeconomic indicators and CO_2 emissions

Scenario	GDP			Unemployment			CO_2 emissions		
	2008	2012	2020	2008	2012	2020	2008	2012	2020
	Change compared to the Reference Scenario								
1.	100%	100%	100%	100%	100%	100%	100%	100%	100%
2a.	100.91%	100.87%	100.79%	95.04%	94.34%	93.48%	100.27%	100.27%	100.27%
2b.	101.59%	101.52%	101.39%	91.13%	90.19%	88.70%	100.48%	100.48%	100.46%
2c.	103.17%	103.04%	102.78%	82.27%	80.75%	77.83%	100.95%	100.95%	100.93%
3a.	100.20%	100.18%	100.12%	98.23%	97.74%	98.26%	97.10%	95.54%	92.13%
3b.	100.45%	100.74%	100.62%	96.81%	94.34%	94.35%	96.55%	95.20%	90.26%
3c.	100.72%	101.15%	101.00%	95.39%	91.70%	91.30%	95.61%	93.90%	87.11%

Scenario	GDP (million USD)			Unemployment (millions)			CO_2 emissions (Mt)		
	2008	2012	2020	2008	2012	2020	2008	2012	2020
	Absolute change			Absolute values					
1.	748.4	855.4	1,110.7	2.82	2.65	2.30	371.17	395.78	449.66
2a.	755.2	862.8	1,119.5	2.68	2.50	2.15	372.18	396.85	450.86
2b.	760.3	868.4	1,126.1	2.57	2.39	2.04	372.94	397.66	451.75
2c.	772.1	881.4	1,141.6	2.32	2.14	1.79	374.70	399.53	453.83
3a.	749.9	856.9	1,112.0	2.77	2.59	2.26	360.41	378.13	414.27
3b.	751.8	861.7	1,117.6	2.73	2.50	2.17	358.37	376.78	405.85
3c.	753.8	865.2	1,121.8	2.69	2.43	2.10	354.87	371.65	391.70

Table 3 shows that while emissions will grow in all scenarios because of anticipated economic growth, Scenarios 3a, 3b, and 3c have much lower rates of emission growth than the other scenarios. This is primarily because scenarios 3a, 3b, and 3c assume that proceeds from emission trading would be reinvested in carbon mitigation, instead of the opportunities throughout the economy with the highest return. A particularly interesting result is that the lowest growth of emissions occurs in the guarantee fund scenario (3c), followed closely by the no-interest loan scenario (3b), indicating the importance of leveraging financing for carbon mitigation. Economic growth is greatest and unemployment is lowest under the second set of cases (2a, 2b, and 2c) in which proceeds from emission trading are invested in the sectors with the highest return, with no emphasis on carbon mitigation. However, these cases also show the highest level of emission growth.

In addition to modeling greenhouse gas emissions, FEWE also estimated how flexible mechanisms might influence sulfur dioxide emissions. Table 4 presents modeling results on the changes in Polish SO_2 emissions under the different scenarios.

Table 4. Changes in Polish SO_2 emissions

Scenario	Changes in SO_2 emissions (thousand tons)		
	2008	2012	2020
1	0	0	0
2a	5	5	4
2b	9	8	6
2c	19	17	13
3a	-56	-80	-107
3b	-67	-86	-132
3c	-86	-109	-175

It is clear from these data that implementing the emission mitigation scenarios (3a, 3b, or 3c) generates the greatest SO_2 emission reductions.

Bottom-up Analysis of Emission Trading

Top-down macroeconomic assessments are useful in understanding how a policy may affect the economy as a whole. However, top-down assessments may not adequately factor in market imperfections, such as high commercial risk or institutional barriers. Poland and other countries in transition are more likely than countries with long-standing market economies to have market imperfections. Rather than ignore this potential bias in the research, the authors of these studies decided to supplement the top-down analysis with a more detailed bottom-up analysis in a few specific sectors. The sectors and the opportunities within these sectors were picked based on their potential ability to mitigate greenhouse gas emissions and improve troubling economic problems, such as high unemployment.

These bottom-up studies cover potential mitigation measures in buildings, renewable energy, and transportation. The three studies are briefly summarized below. This article then provides a more in-depth look at buildings and renewable energy, the two main case studies in this series.

1. **Energy efficiency in buildings**. This portion of the assessment analyzed the impact of reinvesting emission trading proceeds into improving heat efficiency in buildings. Former coal miners could be retrained as energy efficiency technicians, which would simultaneously solve unemployment problems in the coal sector and provide labor to expand this new service-oriented industry.

2. **Renewable energy**. FEWE assessed the potential benefits and costs of using emission trading revenue to help boost renewable energy development, particularly biomass resources grown on Polish farms. The Polish agriculture sector faces chronic unemployment, which the government feels is a key barrier to modernizing the Polish economy.

3. **Transportation**. In this portion of the assessment, the Polish team analyzed the potential of promoting sustainable transportation systems through investments from emission trading revenue.

FEWE selected these case studies and sectors based on several criteria, including their potential effect on greenhouse gas emission reductions, their ability to efficiently use the flexible mechanisms, their convergence with other government policies and their associated labor and social benefits.

Case Study on Energy Efficiency in Buildings

Energy Efficiency Policies in the Buildings Sector
Currently, Poland uses about 42% of its primary energy consumption to supply heat and hot water to residential and public buildings. The residential sector accounts for 35% and the public sector for 7% of the total. Because buildings

account for such a significant share of Poland's energy use, they can play an important role in reducing greenhouse gas emissions through energy efficiency measures.

This case study examines the potential to improve heat efficiency in Polish residential and public buildings as part of a sustainable development strategy for the energy sector. In assessing policy options for implementing the 1998 Law on Energy Efficiency in Buildings, the Polish Ministry for Economy developed a reference scenario that considers using money from the state budget for implementing energy efficiency projects in the buildings sector. The Law on Energy Efficiency in Buildings established a fund, housed at the Bank of the Domestic Economy, to finance projects that improve heating efficiency in buildings. The fund subsidizes 25% of the value of energy efficiency loans. Examples of energy efficiency measures financed under this program include optimizing wall and attic insulation, modernizing and automating heat substations, and installing thermostatic controls and meters. Such measures can provide a payback period ranging from 2 to 7 years, depending on existing energy efficiency levels, local energy prices, and interest rates.

By implementing building-sector projects with simple payback periods of up to 7 years[4], Poland can reduce energy consumption by the equivalent of 2,300 MW per year. Simultaneously, the cost of heating buildings will drop by about 30%. Improving energy efficiency in the residential sector will also help bring household spending on energy closer to Western norms, or approximately 8% of household income. On a macroeconomic scale, FEWE estimates that implementing such projects over the next 14 years could bring an additional 3.4 billion Polish złoty to the state budget. Such projects would also have a significant impact on reducing greenhouse gas emissions.

Case Study Design

FEWE's team calculated the volume and cost of potential improvements in residential building energy efficiency. It used detailed data on the housing stock, breaking it into building type and year of construction.[5] This data also included information on the amount of housing stock in each category. The team then used an extensive database of actual energy audits and energy efficiency improvements to determine the typical energy savings and costs per square meter for full energy efficiency upgrades and full upgrades without replacing the windows. This database allowed FEWE to develop coefficients that could be applied to each category of housing stock. The team then ran a simulation to assess the economic impact of the energy efficiency upgrades using different volumes of capital available emission trading and different investment mechanisms (subsidies, interest-free loans or grants). The team used a simple spreadsheet model developed by the National Agency for Energy Conservation for this simulation.

Impact of Emission Trading on Emission Reductions. Energy Efficiency in Buildings[6]

While the Law on Energy Efficiency in Buildings promotes investment in the buildings sector, the Law does not have provisions for using the additional money that Poland might receive from emission trading under the Kyoto Protocol if the Protocol is ratified.

This study assessed the impact of investing the proceeds of emission trading in energy efficiency in buildings. The study looked at three potential levels of revenue from emission trading: $70 million, $40 million, and $10 million per year over a 5-year period starting in 2003. These investments are what would likely be available based on the amount of AAUs for sale, the price of AAUs, and the level of ET revenue that policy makers may want to allocate on specific climate change mitigation policies. (Thus, this revenue represents only a portion of what Poland might receive from emission trading, as described in the scenarios above.) FEWE picked 2003 because investing early would allow Poland to be prepared in time for the first budget period, beginning in 2008. Early investment would also support the process of restructuring and would allow Poland to have more allowances available for sale during the first budget period.

FEWE considered three mechanisms for investing the money into energy efficiency measures in the buildings sector subsidies, interest-free loans, and loan guarantees. These three mechanisms are described in more detail below.

---

[4] The energy efficiency fund will support projects that provide paybacks of up to 7 years.

[5] Specifically, the FEWE team divided the building stock into single family homes and 5-, 8- and 12-story multifamily homes, and also grouped them depending on whether they were constructed before 1960, from 1960-85 and 1985-1993.

[6] This section refers to energy efficiency measures to reduce heat losses in Polish residential and public buildings.

Subsidies. The government could provide subsidies by creating a specialized energy efficiency fund. This fund should be independent from the existing fund in the Bank of the Domestic Economy, set up under the Law on Energy Efficiency in Buildings. Creating an independent fund seems necessary because the Law on Energy Efficiency in Buildings, in practicality, covers only buildings built before 1993. The new fund would have different operating rules to better meet the investment needs of an emission trading regime, while at the same time providing an acceptable payback period and lowering the costs and risks of the investments. The new energy efficiency fund could be located in a private bank chosen through an auction. The winning bank would receive a commission equal to 5% of the fund's annual income for operating the fund. Twice a year the independent energy efficiency fund could announce a competition for financing energy efficiency projects in the buildings sector. The size and payment schedule for the grants would be determined on a project-by-project basis. Energy audits would be used to estimate emission reductions and the net cost or benefit of those emission reductions. The Fund would only finance profitable projects with positive net present values. This type of financial mechanism would have two advantages: (1) it would reduce GHG emissions as a result of energy efficiency projects, and (2) the government would be able to sell emission reductions and reinvest the proceeds in the fund.

Interest-free loans. Alternatively, the Polish government could make interest-free loans available through an independent energy efficiency fund. The fund would operate very much like the one described above, except that it would provide loans instead of grants. This would likely necessitate some level of credit check on the prospective loan recipients, as well as an administrative structure to approve loans and collect payments. Loan recipients would have a financial stake in the outcome of their projects, so they would likely try harder to make the projects succeed.

Loan guarantees. A third option is for the Polish government to provide loan guarantees through a specialized fund. The fund would be structured much like the grant-making fund described above, but the fund would provide guarantees for third-party loans instead of outright grants. Such guarantees would make private financing easier to obtain and would reduce the financing costs by lowering the risks. The guarantee fund would promise to pay creditors in case the loan recipient defaulted. Some credit checks on the guarantee recipients would likely be necessary. Administratively, a guarantee fund would be relatively easy to operate because it would only transfer money in rare cases. Most of the money in the fund could be invested to provide interest income, which could offset any losses from default payments. To maximize its impact, the fund could concentrate on providing guarantees for customers who are not qualified to receive loans under the Law on Energy Efficiency in Buildings.

Table 5 presents the potential energy savings and emission reductions if proceeds from emission trading were invested in energy efficiency projects as described in this case study.

Table 5. Annual energy savings and CO_2 emission reductions resulting from investing proceeds from emission trading during first commitment period (2008-2012)

Type of fund		Level of financing (million USD)					
		70		40		10	
		Energy savings (TWh)	Emission reductions (Mt C)	Energy savings (TWh)	Emission reductions (Mt C)	Energy savings (TWh)	Emission reductions (Mt C)
Independent energy-efficiency fund providing project grants	100% grant	1.85	0.356	1.055	0.204	-	-
	30% grant	6.17	1.187	3.515	0.680	-	-
Interest-free loan fund		9.25	1.780	5.3	1.017	1.32	0.254
Loan guarantee fund		4.62	0.890	2.64	0.510	0.66	0.127
Interest earnings on loan guarantee fund [7]		6.16	1.187	3.0	0.680	0.88	0.170

[7] Because the money set aside for the guarantee fund would remain in the fund except in case of default, this money could earn significant interest. This line describes that interest income.

In addition to energy savings and emission reductions, the study assessed the potential number of new jobs that would be created in the construction sector as a result of energy efficiency investments (see Table 6).

Table 6. Potential job creation from emission trading investments in energy efficiency

Type of fund		Level of financing (million USD)		
		70	40	10
		Number of jobs	Number of jobs	Number of jobs
Independent energy efficiency fund providing project grants	100% grant	5,029	2,874	-
	30% grant	16,763	9,580	
Interest-free loan fund		25,145	14,370	3,593
Loan guarantee fund		12,573	7,185	1,796
Interest earnings on loan guarantee fund		16,614	9,494	2,373

Investing money from emission trading into energy efficiency in buildings would have a large impact on energy savings and emission reductions. Well-designed energy policies and incentives could play an important role in systematically improving energy efficiency in buildings.

Renewable Energy Case Study

This case study analyzes and evaluates the potential opportunities for developing renewable energy in Poland using investments from emission trading and joint implementation. Renewable energy is not well developed in Poland today because of its high capital expenses and long payback periods. Revenue from emission trading could boost the development of renewable energy. Because biomass is one of the most promising sources of renewable energy in Poland, renewable energy also presents an opportunity for the agricultural sector. Polish farms today face high levels of unemployment and working farmers often receive poor wages. Biomass development could provide a new source of income for these farms, which could also help Poland in its efforts to modernize its agricultural sector. Finally, renewable energy can help reduce GHG emissions.

FEWE used the results from two other studies in this analysis:

- A report called "Economic and Legal Aspects of Using Renewable Energy in Poland" that the Baltic Renewable Energy Center prepared for the Minister of Economy in March 2000. The report provides a description of existing renewable energy technologies and their costs.

- A study prepared as part of this assessment on investing revenue from emission trading in the renewable energy sector. Three different investment levels were considered: $70 million, $40 million, and $10 million per year for a period of 5 years (2003-2007).[8]

The team then used a model called the Strategic Assessment Framework for the Implementation of Rational Energy (SAFIRE) to assess the potential impact of investments in renewable energy on economic development and emissions. The European Commission funded the development of SAFIRE in order to evaluate the impact of new energy technologies and policies on a number of economic and environmental indicators. These indicators include economic growth, market penetration, employment, emissions, import dependency, and capital expenditures. Researchers use the model for a variety of applications, including local, national, and EU policy and planning, cost benefit analyses for public institutions, and market assessments for companies. SAFIRE is organized as a bottom-up engineering economic model paired with a database covering 32 countries, including Poland.

[8]These investment levels are based on the scenarios above but they also factor in the amount of emission trading revenue that policy makers might be willing to allocate for renewable energy.

Currently, renewable energy production in Poland equals 103 PJ per year or 2.5% of the primary energy balance in Poland. Taking the current situation as a starting point, the scenario developed for this case study then assesses the potential of increasing renewable energy's share by three times from 2.5% to 7.5% of the primary energy balance by 2010 through flexible mechanisms and targeted energy policies. This growth would lead to an increase in installed renewable capacity of 18.3 GW. Energy production from renewable sources would reach 340 PJ per year, accordingly.

The Baltic Renewable Energy Centre (EC BREC) and FEWE assumed that new funds would be available from emission trading to invest in renewable energy. The FEWE team evaluated alternative options for investing $70 million, $40 million and $10 million per year, respectively, into Polish renewable energy from 2003 to 2007. These dates were selected based on the need to prepare Poland for the first Kyoto budget period and the potential for forward contracts for emission trades before the first budget period. Table 7 summarizes the results of this case study.

Table 7. Proposed emission trading investments for renewable energy

Investment available from emission trading from 2003 to 2007 mill. USD/yr (mill. złoty /yr.)	Total investments From 2003 to 2007 million złoty	Additional installed capacity of renewable energy sources from 2003 to 2007 MW	Additional energy production from renewable energy sources in 2007 PJ/yr
70 (315)	11,211	13,462	165.5
40 (180)	6,404	7,693	94.7
10 (45)	1,601	1,923	23.7

The results of the assessment indicate that if renewable power developers could receive funds from emission trading, they would be more likely to invest in new renewable energy sources. Funds from emission trading would also help improve the return on these investments.

Because of this case study and other similar documents, the Ministries of Economy and Environment decided to adopt a more ambitious target that would increase the share of renewable energy to 7.5% of primary energy supply by 2010. Previously the policy target had been 5%. The revised target takes into account the benefits Poland can reap from emission trading. The governmental document "Strategy for Renewable Energy Development" adopted on September 5, 2000, lays out this new target and other goals for developing renewable energy in Poland.

Poland's Opportunities to Mitigate Carbon Emissions

Both the macroeconomic analysis and case studies show that Poland stands to benefit from emission trading. In fact, FEWE's modeling efforts indicate that the Polish economy would grow by as much as 3% as a result of emission trading. This growth would be in addition to the economic growth the government currently forecasts. Unemployment would also go down as a result of emission trading investments. Greenhouse gas emissions could be either higher or lower than current predictions, depending on how proceeds from emission trading are invested. Even under the high emission growth scenario, emissions will likely not exceed levels agreed to in the Kyoto Protocol, though emissions would be lower if proceeds are invested in carbon mitigation options.

FEWE's analysis also found that unemployment in the coal and agriculture sectors could be reduced by carefully targeting investment of emission trading proceeds. FEWE examined two case studies to understand these options in more detail. In one, it assumed that coal miners could be retrained as energy efficiency technicians in order to retrofit buildings with heat saving measures. In the second, FEWE examined the impact of expanded use of biomass energy on employment in the farming sector. Both these options could help increase long-term employment in sectors currently facing major labor difficulties.

FEWE also found that the Polish government could maximize economic growth and carbon mitigation if it uses innovative mechanisms for re-investing the proceeds of emission trading. Specifically, the analysis showed that it is

much more cost-effective to use mechanisms such as interest-free loans and loan guarantees, rather than government subsidies. Two factors in particular influence this:

1. Interest-free loans and guarantees provide leverage, which would allow the Polish government to encourage much larger-scale investments than its own resources would allow; and

2. Investors and project developers are more likely to have strong incentives to manage investments well and achieve results if they must pay the investments back than if they are using "free" money.

It is prudent for Poland to begin work on mitigation now to maximize the country's economic benefits from emission trading and ensure that the country will be in a strong position to meet its obligations international climate agreements for many years to come. Given that there are and always will be significant uncertainties associated with future emissions and emission allowances, Poland will likely want to maintain a reserve of emission allowance for the first budget period.

Emission trading can benefit the Polish economy and environment: revenue from emission trading can have a direct benefit on the Polish economy and secondary benefits through re-investment in economic growth and emission mitigation. Moreover, Poland can use the revenue from emission trading to deepen or accelerate structural reform in key sectors. Such structural reform can have a long-lasting, positive impact on Poland's sustainable development.

Appendix 1. Reports prepared under this assessment

1. Ewaryst Hille at al. "Evaluating the economic impacts of emission trading on GHG emission reductions in Poland." 2001.
2. Milosz Rojek and Zygmut Parczewski. "A macroeconomic evaluation of the potential use of funds from GHG emission trading to implement a sustainable development scenario and further reduce GHG emissions." 2000.
3. Milosz Rojek. "Assessment of possible developments in the international market for GHG emission allowances." 2000.
4. Grzegorz Wisniewski and Sandra Pronczuk. "Evaluation of various options to use emission trading revenue for renewable energy development." 2000.
5. Arkadiusz Weglarz. "Opportunities for emission reductions and energy savings using revenue from emission trading in energy efficiency projects in buildings." 2000.
6. Andrzej Brzezinski and Piotr Szagala. "Evaluation of opportunities for using potential revenue from emission trading for sustainable development of the country and reduction of emissions in the transportation sector." 2000.
7. Stanisław Szukalski. "Macroeconomic study of the national economy." 2000.
8. Andrzej Kassenberg. "Evaluating opportunities to use potential revenue from emission trading for sustainable development of the country and emission reductions by shaping demand for transport services and restructuring the transportation sector." 2000.
9. Ewaryst Hille. "Long term vision for Polish society and its economic development." 2001.

All reports were released by FEWE in Warsaw, Poland.

Bibliography

Academic Center for Environmental Education. 2000. *Optimization of Energy Stock Utilization for Environmental Protection in Poland*. Academic Center for Environmental Education. Warsaw.

Cabinet of Ministers of the Republic of Poland. 2000. *Assumptions on State Energy Policy through 2020*. Warsaw.

Chandler, W., M. Evans and A. Kolesov. 1996. "Climate Change Mitigation: A Review of Cost Estimates and Methodologies for the Post-Planned Economies," *Energy Policy*, 927-935.

Czech, E. 2000. *Selected Issues: Legal Problems of the Joint Implementation Mechanism and Commercial GHG Emissions in Poland*. National Fund for Environmental Protection and Water Management. Warsaw.

Danish Wind Turbine Manufacturers' Association. 1996. "Employment in the wind power industry." *Wind Power Note* No 2. Copenhagen. Available at http://www.windpower.dk/publ/wpnemple.pdf.

"Development of State Transportation Policy for 2000-2015." 2000. Ministry of Transport and Sea Commerce. Warsaw.

EC Baltic Renewable Energy Center. 2000. "Economic and Legal Aspects of Using Renewable Energy in Poland." Ministry of Economy of the Republic of Poland. Warsaw.

ECOTEC. 1995. "The Potential Contribution of Renewable Energy Schemes to Employment Opportunities," ECOTEC Research & Consulting. ETSU K/PL/00109/REP. Birmingham, UK.

European Wind Energy Association. 1997. "Wind energy. The facts," *Report for EU's ALTENER*. London.

FEWE. 1999 "Update on Macro-Economic and Sectoral GHG Reduction and Removal Scenarios till 2020." National Fund for Environmental Protection and Water Management. Warsaw.

FEWE. 1996. *Strategies of GHG Emission Reduction and Adaptation of the Polish Economy to the Changed Climate. Polish Country Study to Address Climate Change*. FEWE, Warsaw.

Government of the Republic of Poland. 2000. *Strategies for Renewable Energy Development*. Warsaw.

Jedrusik, E. 1998. *Węglowy Fundusz Inwestycyjny Banku Swiatowego jako mechanizm wspierania realizacji zobowiązań wynikających z Protokółu z Kioto*. Polish Ministry of Foreign Affairs and Ministry of Justice. Warsaw.

Kropiewnicki, R. 2000. "Potencjał redukcji emisji dwutlenku węgla wynikający z termorenowacji budynków wykonanych w technologiach wielkiej płyty w cyklu ich użytkowania" The Polish National Energy Conservation Agency. Warsaw.

Main Statistics Department. "1999 Statistical Yearbook of the Polish Republic". Main Statistics Department. Warsaw. 1999.

Ministry of Economy. 2000. *Foundation of Power Policy in Poland through 2020*. Ministry of Economy. Warsaw.

Ministry of Transport and Sea Commerce. 2000. *Principles of State Transportation Policy in Poland for 2000-2015*. Warsaw.

Phylipsen, G., K. Blok and K. Dreborg. 2000. "COOL: Path Analysis." *Report of Workshop 2*. Brussels, 2000. COOL Europe. Wageningen.

Polish Institute for Sustainable Development. 1999. *Policy Alternatives for Polish Transportation According to Sustainable Development Principles*. Report 4/1999. Warsaw.

Polish National Energy Conservation Agency. 2000. "Analiza ograniczeń zakresu przedsięwzięć termomodernizacyjnych w budynkach mieszkalnych, wynikających z warunków ustawy z dnia 18 grudnia 1998r. o wspieraniu przedsięwzięć termomodernizacyjnych, z propozycjami zmian warunków zapisanych w ustawie dla rozszerzenia zakresu przedsięwzięć termomodernizacyjnych." Ministry of Finance. Warsaw.

Pollard, V. 1998. "Renewable energy and new labor places", *Proceedings of an International Seminar on Renewable Energy within Strategies for Sustainable Development*. Warsaw.

OECD. 1997. *Lessons from Existing Trading Systems for International Greenhouse Gas Emission Trading, Annex I Expert Group on the UNFCCC: Information Paper*. OECD. Paris. At http://www.oecd.org/env/docs/cc/epoc9813r1.pdf.

Olecka, A. 2000. "CO_2 Emission Cap in Poland - Overall Allocation." National Fund for Environmental Protection and Water Management. Warsaw.

Reklewski, T. 2000. "Baselines of fuel replacement projects." National Fund for Environmental Protection and Water Management. Warsaw.

UN FCCC Secretariat. 1998. *Second Compilation and Synthesis of the Second National Communications: Addendum*. Doc. FCCC/CP/1998/11/Add.2. Bonn.

World Energy Council. 1999. *Survey of Energy Resources 1998*. WEC. London.

World Resources Institute. 2000. *Capacity for Climate Protection in Central and Eastern Europe - Activities Implemented Jointly*. Regional Environment Center. Szentendre, Hungary.