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"*It appears that the summer of 2003 was very likely warmer than any other summer in Europe back to 1500*" (Luterbacher, 2004). This was the conclusion of a study about the changing climate of Europe by climatologists at the University of Bern, Switzerland, and published in Science in May, 2004. The study collected and analyzed data across Europe including old temperature, soil core, and tree ring records. This study also found evidence that 50% of mountain glaciers have shrunk in the past century in Europe, and some ice fields lost 10% of their mass last summer alone. Even though Luterbacher's study did not analyze the effects of human activity on earth's warming, other climatologists, including Stephen Schneider, of Stanford University, a prominent advocate of the idea that most global warming is human caused, argue that Luterbacher's study agrees with models that have predicted the impact of burning fossil fuels and the release of greenhouse gases (GHG) on rising global temperatures.

The Intergovernmental Panel on Climate Change (IPCC), a group of eminent scientists, unanimously concluded in their reports in 1995 and 2001 that '*there is new and stronger evidence that most of the warming observed over the*

last 50 years is attributable to human activities' (anthropogenic sources) and predicted between 1.4 and 5.8 degrees Celsius (^{o}C) rise in global temperatures by the end of the century. The IPCC also concluded that steps must be taken to control emissions from a specific basket of GHG emissions, namely, carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), sulfur oxide (SO_4), and industrial gases - hydro fluorocarbons (HFCs), per fluorocarbons (PFCs) and sulfur hexafluoride (SF_6). This consensus led to the birth of the Kyoto Protocol in1997, at the global climate change conference in Kyoto, Japan.

Despite the evidence of rising global temperature and its possible effects, some argue for more research to understand this phenomenon. The European Union (EU), conscious of the increases in global temperatures, is taking steps to reduce fossil fuels use, the main source of GHG emissions, and promote renewable energy, a major recommendation of the Kyoto Protocol. This thesis examines the differences in policies of Germany, Poland, and UK towards reducing GHG emissions and promoting renewable energy, and concludes that, even though the countries are pursuing similar policies, their implementation differs primarily because of their different idiosyncrasies and institutional make up. Lucas 1981 reached similar conclusions in his studies.

I also found that the "wall fall profits" (German investments in energy efficiency systems in former East Germany after re-unification), the "dash for gas" (substitution of natural gas for coal in UK's fuel mix), and reforms in the Polish coal industry since 1988 have been the most effective GHG emissions reduction policies for Germany, UK, and Poland respectively.

The GHG emissions reductions results of Germany, UK, and Poland, and their current GDP growth rates compared to other countries not aggressively implementing the Kyoto Protocol's recommendations, are evidence that the Kyoto Protocol can help reduce GHG emissions without significantly reducing economic development.

The Underlying Differences in Greenhouse Gases (GHG) Emissions Control and Renewable Energy: Three European Countries Approaches to Policy

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"We all live down stream," this statement has over time become even more important to me. As part of living down stream, we all depend on the goodwill of others in many different ways. I would not be what I am today without the invaluable support of family, friends, and the numerous well-wishers I have come to know and personally admire. To all of you who believed in me, I doff my cap to you.

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ACRONYMS AND ABBREVIATIONS USED IN THIS THESIS

AIJ	activities implemented jointly
CCLA	climate change levy agreement
CCL	climate change levy
CER	certified emissions reduction
CHP	combined heat and power
COP	the conference of the parties to the UNFCC
Dnc	declared net capacity
ECCP	European climate change program
EEC	energy efficiency commitment (UK)
EEC	European Economic Community, the economic arm of EU
EEG	renewable energy source act (Germany)
EESOP's	energy efficiency standards of performance (UK)
ETG	emissions trading group (UK)
ETS	emissions trading system/scheme
GHG	greenhouse gases
GDP	gross domestic product
IEA	international energy agency
IPCC	intergovernmental panel on climate change
IPP	independent power producers
JI	joint implementation
KfW	reconstruction loan corporation (Germany)
N-TPA	negotiated third party access
NRE	new and renewable energy
NFFO	non-fossil fuel obligation
OECD	organization of economic corporation and development
Ofgem	office of gas and electricity markets
REC	renewable energy certificates
REC's	renewable energy certificate systems

RES	renewable energy sources
ROC	renewable obligation certificate
R-TPA	regulated third party access
TPA	third party access
UNFCCC	United Nations framework convention on climate change

UNITS OF MEASUREMENT

BTU	British thermal unit
CO_2e	carbon dioxide equivalent
Dnc	declared net capacity
GW	gigawatt
Ktoe	thousand tones of oil equivalent
kWh	kilo watt hour
kWh/a	kilo watt hour per annum
GWh	gigawatt hour (1 million kWh)
gC_{eq}/kWh	grams of carbon equivalent per kilowatt hour
e/kWh	eurocents per kilowatt hour
Mt	million tones
Mtoe	million tones of coal equivalent
Mtce	million tones of oil equivalent
$MtCO_2e$	million tones of carbon dioxide equivalent
MW	megawatt
PJ	petra joule (10^{15} joules) power equivalent
p/kWh	pence per kilo watt hour
tC	tones of carbon
tCe	tones of carbon equivalent
tCO_2	tons of carbon dioxide
tCO2e	tones of carbon dioxide equivalent
toe	tone of oil equivalent
TW	terawatt
TWh	terawatt hour (1 billion kWh)

Chapter One

1.1-1 Introduction

The need to find and use viable alternatives to our continued reliance on fossil fuels as our main energy source became apparent when the Inter-Governmental Panel on Climate Change (IPCC), an independent scientific body under the umbrella of the United Nations, published its reports about earth's warming in 1990 (Brack &Grubb,1996). It reiterated in its 1995 and 2001 reports that increased warming of the earth in the twentieth century is most likely caused by anthropogenic (human-caused) emissions (IPCC, 2001). Figure 1-1 shows evidence of an increasing trend in earth's surface temperature in the 1990s. According to Rajendra Pachauri[1], scientists agree that increases in CO_2 and other greenhouse gas (GHG) emissions will trap heat in the planet's atmosphere, a situation that can lead to an upsurge in natural disasters and other consequences. The build up of CO2 emissions in figure 1-2 also confirms scientists' concerns about global warming.

The IPCC reports, and the evidence in figures 1-1 and 1-2, set the stage for the development of the Kyoto Protocol on Climate Change at Kyoto, Japan, in 1997. This Protocol required industrialized countries (annex B[2]) to reduce their GHG emissions by 5.2% from 1990 by 2012. Russia's ratification[3] in November 2004 makes the Kyoto Protocol operational. Ratifying countries are required to achieve their stated GHG emissions reduction between 2008 and 2012. The Kyoto Protocol also suggested methods that will help countries achieve their emissions reductions. These include:

- Clean development mechanisms (CDM) - investments in GHG emissions reduction projects in annex A countries undertaken by annex B countries. This is designed to establish energy efficiency structures in annex A and

[1] He is the current Chairman of IPCC

[2] Under Kyoto Protocol negotiations, annex A refers to the developing countries of the world while annex B countries are the world's rich and industrialized countries

[3] This is a formal acceptance and proof that a country is committed to implementing locally the Kyoto Protocol's conditions (GHG emissions reduction). Most countries have signed but not ratified the Protocol. This means such countries are not bound by the Protocol's conditions

- emissions reduction credits for annex B countries, and hopefully global GHG emissions reductions.
- Joint implementation (JI) involves countries coming together to pursue programs that lead to achieving their GHG emissions reduction quota. It also includes investments in specific GHG emissions reduction projects from one country to another that allows the investing country to reap emissions reduction credits.
- Emissions trading (ET) allows each participant in the system a specific quantity of GHG emissions over time. However, participants can trade these allowances; one may emit more, if another agrees to emit less and sell the balance of their emissions allowance to the first. The price of emissions is based on the differences in marginal abatement costs.

The problem of earth's warming as discussed at Kyoto continues to generate economic and political responses. Some countries believe the provisions of the Kyoto Protocol will increase production costs and adversely affect economic growth because emissions reductions will require cuts in the use of fossil fuels (Vrolijk, 2002). This concern about rising costs underlines the stated position of the current US administration.[4] Also, most businesses are not acting to safeguard their investments against the possible risks and uncertainties of global warming. For example, in a survey of the world's 500 largest companies 80% of respondents recognized global warming as a financial risk but only 40% have taken action to mitigate the dangers it poses (Johnson, 2003).

The agriculture and tourism industries constitute the primary subsistence and revenue generating sectors of most countries. These industries are the most vulnerable to natural disasters that may result from increasing temperatures of the earth's surface. Arguably, one catastrophic consequence of the temperature increase was evident in the recent heat wave across Europe that killed about 19,000 people (Luterbacher, 2004). According to Luterbacher, 2003, "the *long trend of warming temperatures is now melting the high altitude permafrost – the*

[4] In 2001, President Bush withdrew US participation in the Kyoto Protocol negotiation, citing among other reasons the cost of emissions reduction on the US economy. This position was supported by many US businesses.

soil that usually remains frozen year-round and that some buildings, bridges and road ways are now threatened with unstable foundations." The effects of increases in global temperatures, even though slow to manifest, represent a wake up call to world governments.

The putative cost of implementing the Kyoto Protocol standards on economic development is one of the issues preventing action by some countries (Vrolijk, 2002). According the IPCC, the cost is estimated to reach $18 quadrillion by 2100 (IPCC, 2003). The projected cost breaks down to 1% of GDP in a best case scenario and 4.5% of GDP in a worst case scenario by 2050, according to IPCC estimates.

Despite these concerns, there is evidence of a positive economic and job creation effect of GHG emission reduction and the use of renewable energy. According to Hans Christian Schmidt, the Danish Environment Minister, the Kyoto Protocol's provisions *"are good for the environment, good for enterprises and also good for the economy."* Reducing carbon emissions will bring big rewards for companies and translate into employment opportunities. The renewable energy market is projected to grow to around $1.9 trillion by 2020 from between $234 billion and $625 billion in 2010, according to the Carbon Disclosure Project (Johnson, 2003). Lovins, et al., 1997[5] also argues, *"investments in energy efficiency and renewable energy yield two to ten times as many jobs as investments in fossil fuels and nuclear energy. Incinerating a million tons of solid waste requires eighty workers, but recycling the same waste, takes sixteen hundred workers employing all these additional workers would have other benefits as well, including higher tax revenues for governments and lower welfare costs."* The Royal Commission on Environmental Pollution in the UK and the Prime Minister (Tony Blair) agreed at the launching of the Climate Change, 2000 Program[6] that; the program will lead to more employment

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[5] Factor Four: Doubling Wealth, Halving Resource Use, made Amory Lovins a credible voice on environmental issues. The Wall Street Journal named him one of the eighty - eight people in the world, most likely to change the course of business in the 1990 s.

[6] See Chapter 4 below.

opportunities through the development of new environmental technologies (Blair, 2000).

These global warming related issues call for a rethinking of the world's energy policies. The European Union (EU) has become the beacon of the global community in GHG emissions reduction and the promotion of sustainable renewable energy.

This thesis will look at the policies of Germany, Poland and the United Kingdom (UK), in their search to reduce GHG emissions and promote the use of renewable energy. These three countries were chosen because they represent different parts of the EU story. Geographically they are different, but politically and economically they are affiliated with the EU and are therefore required to meet its policy regulations. Poland is in Eastern Europe and the third largest polluter in Europe. It has embarked on environmental reforms as part of its EU membership. Germany and UK are both primary members of the EU but currently at different development stages in their GHG emissions and renewable energy programs. Each country's renewable energy policies will be considered against the backdrop of their institutional effects and how they fit into the overall renewable energy goals of the EU.

This thesis will catalog the national policies regarding GHG emissions and renewable energy under the following categories: (1) overview, (2) legal reforms, (3) achieving objectives at a low cost comparatively,
(4) incentives for innovation, (5) effects of policies on different sectors of the economy, (6) global positioning purposes, (7) meeting EU membership requirements, (8) national security objectives. Also, analysis will be provided for each country, concerning legal, emissions trading, flexible and fiscal policies, as well as their environmental politics. Conclusions will be based on insights of the underlying differences in approaches to GHG emissions reduction and the promotion of renewable energy.

Chapter Two

2.1-1 Literature Review

There has been little effort at cross-country comparisons of policy approaches to GHG emissions reduction, promotion of renewable energy, and reasons for these differences.

Energy supply structures vary across countries and are a compromise between technology and the general political traditions and priorities of a country. One of the most interesting aspects of European energy supply is the diversity of organizational forms. National idiosyncrasies in structure often produce different emphases in national policies (Lucas, 1981).

This distinction by Lucas is very important to this study because each country in this study is an EU member. Therefore, they are collectively bound by EU GHG emissions reduction and renewable energy policies. Germany's coal endowment and use in energy production led to environmental destruction in the 1980 s. Poland, like Germany, uses coal extensively and is one of the world's leading producers and exporters of coal. UK's geographical location endows it with petroleum and natural gas. Since all these energy sources are fossil fuels and therefore emit GHG, each country will have to reduce its dependence on such energy sources as a way to reduce GHG emissions and fulfill EU GHG emissions reduction and renewable energy policies.

North, 1990, writes about the role of institutions and their impact on policies of countries. He argues that, to develop an understanding of institutions, we must explore in depth the structural characteristics of informal constraints, formal rules, enforcement mechanisms, and the way in which they evolve. Each of the three countries in this study has evolved politically and economically in its choice of environmental and renewable energy policies. The studies by Lucas, and North, will be useful to this study because I expect that the idiosyncrasies in energy supply structures and the different interest groups and other institutions in the various countries will likely be manifest in different policy responses to EU GHG emissions reduction and renewable energy policies. I hope to explain the

underlying differences in GHG emissions and renewable energy policies of the three countries by examining the role of institutions in the various countries from North's perspective.

Chapter Three

3.1-1 Overview of the EU

The EU hopes to become a global leader of "low carbon emissions economies[7]" (McGowan, 2000). The EU currently comprises 25 countries, having increased from 15 on May 1st, 2004. In 2003, EU GDP in 2003 Euros was €2,352,288.9 million and growing by 0.4% in the 4th quarter. The EU has a population of 379 million (2002), an unemployment rate of 8% (2004), and inflation at 1.5 % (2004). Renewable energy currently accounts for 6% of energy consumed (EU Statistics, 2004).

The EU's general objectives are grouped under three "pillars":

- Renewable energy and emissions trading.
- Foreign and security policies.
- Cooperation in justice and home affairs. (EU,1999)

As a result of the climate change negotiations at Kyoto, Japan, in 1997, the EU accepted an 8% reduction EU-wide of the following basket of GHG: carbon dioxide, methane, nitrous oxide, sulfur oxide, hydrofluoric carbons, and chloroform carbons to 1990 levels by 2012 (Vrolijk, 2002). The EU pressed for a single target for the whole of the union with the view of sharing the commitment, or "the bubble,[8]" among member countries. It was believed that this would help strengthen the union and enable it to take advantage of the flexible conditions of acting together under joint implementation (EU, 1999). Article 6 of the Kyoto Protocol stipulates that "*any party included in annex B may transfer to or acquire from, any other such party, emissions reduction units resulting from projects*". This enables the EU to act jointly in pursuing the "bubble mechanism" in its emissions reductions.

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[7] A low carbon emissions economy refers to a country where most industries use renewable energy or energy sources that emit relatively low CO_2 and other GHG that cause global warming.
[8] The bubble refers to an EU agreement on its emissions reduction allocation using the Kyoto Protocol provision (Article 3) that allows for joint reductions. Under the bubble, EU members negotiated the allocation of its 8% reduction of GHG

The EU bubble negotiations among member countries have been innovative. The bubble allocation takes into account the effects of emissions reductions on poor member countries.[9] Poor countries are allowed to increase their emissions or accept lesser cuts while rich member countries accept higher emissions reductions. Figure 3-1 shows each member country's responsibility under the "bubble" (Vrolijk, 2002).

To ensure that there were uniform standards for verifying and measuring GHG emissions reduction under the bubble allocation, the EU liberalization directive (96/92/EC) of 1996[10] was amended by Communication 2001 to promote liberalization of the electricity and gas markets of member countries (Vrolijk, 2002). This directive required all member countries to open their electricity markets to competition. It also called for 80% market liberalization by 2003 (Comm. of E.C, 2001 769). The target date was extended to 2005.

A liberalized single energy market was one way the EU hoped to achieve GHG emissions reduction. The EU also targeted the electricity sector for liberalization, because CO_2 emissions in the sector accounted for about one third of all emissions in the Organization for Economic Cooperation and Development (OECD) countries (IEA, 2000). Increased competition in the electricity market can result in the closure of inefficient power plants (Vrolojk, 2002). The use of new technologies, as result of competition, led to the development of highly efficient industrial scale gas turbines.[11] Increasing the use of natural gas power plants resulted in CO_2 emissions reduction (Heinelt, et al., 2001). CO_2 emissions reduction from the use of natural gas in the UK, figure 7-1, is explained in the analysis chapter. This is also an example of how EU energy market liberalization helped achieve GHG emissions reduction.

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[9] This decision was based on the EU's economic and social cohesion policy. The policy requires making policy decisions that will help reduce disparities between rich and poor member countries.
[10] Liberalization in this context refers to the privatization of electric utilities by promoting competition in the generation and retailing of electricity and also the separation of the ownership of electricity transmission and generation.
[11] Refer to UK's dash for gas program explained in chapter 6.

The EU also promoted emissions trading,[12] as part of its broad market liberalization and GHG emissions reduction plan. EU directive 2003/87/EC[13] was adopted as an amendment to directive 96/61/EC to promote emissions trading within the EU. The objective of the directive was to create the conditions for the effective fulfillment of the emissions reduction commitment of the EU through an efficient EU market for GHG emissions allowances, with the lowest possible reduction in economic development and employment (Comm. of E.C, 2003). An EU green paper on emissions trading also estimates that trading will generate savings of €1.7 million annually (Vrolijk, 2000).

Despite the emissions trading projections, there are still some differences in approaches to the implementation of emissions trading among EU's large countries. The commitment of member countries to engage in real emissions reduction according to the "bubble" allocation continues to be discussed in EU emissions trading as new member countries join the union (McGowan, 2000).

On renewable energy, the EU currently uses 6% of renewable energy in its energy mix.[14] It hopes to double this by 2010 (Vrolijk, 2000). This increase in renewable energy use will help GHG emissions reduction and meet EU's Kyoto requirement. The EU recommend that member countries should adopt renewable energy projects that include some combination of the following: (1) fuel switching - "the dash for gas" in the UK (2) industrial cogeneration - a technology to re-use industrial heat with an electrical capacity of 500kWh for domestic purposes (3) district heating[15]
(4) renewable energy technologies (5) other non-fossil fuel technologies including nuclear (6) supply and demand side efficiency measures in energy (EU, 1999).

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[12] Emissions' trading is the concept of allocating a fixed quantity of pollution permits to all sectors of an economy over time. Companies that desire to pollute more than their permit allocation will have to buy a permit from someone willing to forego using their permit. This supposedly leads to the reduction of pollution over time with the least economic disruption.
[13] Directive 2003/87/EC of the European Parliament is an amendment of directive 96/61/EC; it establishes a scheme for greenhouse gas emission allowance trading within the EU.
[14] This term refers to the various energy sources that make up the total energy supply. For example (hydro, natural gas, nuclear, etc)
[15] This refers to heating distribution systems produced by different technologies or fuels. Most district heating in Poland is from coal, although gas and oil are also used.

These programs are to be adopted based on each country's resource endowment and the feasibility of each program. The EU currently imports about 60% of its energy. The effects of this dependence will create energy supply security concerns. A 2000 green paper on energy security emphasized that higher energy prices increased EU energy security by promoting alternative energy and emissions reduction (Mitchell and Dolun, 2001). As a result of the green paper's recommendation, the EU in 2001 proposed refocusing its energy policy on the demand side. The objective was energy savings and efficiency, and also increasing revenues from energy taxation to achieve a structural shift towards more environmentally friendly uses and sources (Comm. of E.C, 769 2001).

Consensus on the EU proposal for member countries to use energy taxes to restructure energy demand has been difficult to achieve. Low tax countries are mostly unwilling to shoulder higher tax burdens, while high tax countries are unwilling to lose revenue by cutting taxes (Leonard, et al., 1998).

The diversity among EU member countries makes it difficult to implement a broad based policy unless some level of flexibility is allowed. To address this concern, the EU introduced the Single European Act (SEA) 103r. The Act calls for the preservation of member states' rights on environmental matters and limits the EU's decision making capabilities to international agreements, unless the EU as a bloc agrees on specific issues (Anderson, et al., 1997). Cognizant of existing differences among countries and the need to achieve policy goals, the EU decided to promote harmonization and convergence in its policies (Sbragia, 1998). To help achieve convergence, the EU recommended that ad-hoc working groups take into account economic differences between countries in the coordination of environmental policies towards meeting countries' Kyoto Protocol obligations (Leonard, et al., 1998).

As the EU continues to expand, it is plausible that some nations supportive of particular policies may coordinate their support and propose changes in the bubble allocation. A resolution of all outstanding bubble allocation issues will go a long way to help the EU become a global leader and a strong advocate for the Kyoto Protocol goals.

Chapter Four

Map of Germany

4.1-1 Overview of Germany

Germany is Europe's largest economy and most populous nation. Germany's population is 82,398,326 (July 2003), 33.4%, 2.8%, and 63.8% of the labor force of Germany is engaged in industry, agriculture, and services, respectively, and the unemployment rate is 9.8% (2002). Germany's GDP is $2.184 trillion, its real GDP growth rate is 0.4%, and its per capita GDP is $26,600 (2002) (CIA, 2002). Germany is about 357,021 square kilometers (sq km). Emissions from coal-burning utilities and industries are a major challenge. They contribute to air pollution, acid rain, and hazardous waste (MSN Learning & Research, 2003).

Germany ratified the 1997 Kyoto Protocol on Climate Change in May, 2002. This brought to 74 the number of countries ratifying the Protocol.

As a leading member of the European Union, (EU) Germany accepted a 21% emissions reduction, the second largest percentage in the EU. As a result, it must reduce overall emissions of GHG from about 1,200MtCO_2e to 960MtCO_2e a year. This is the highest absolute reduction of any single country. Germany believes the reform of its laws to promote environmental goals will help the country meet its emissions reduction target (Schleich, et al. 2002).

4.1-2 Legal Reforms

The primary goal of legal reforms in Germany was market liberalization, as part of an EU-wide reform policy. Germany also reformed its laws to increase environmental protection and create a policy framework that meets the Kyoto Protocol requirements. The 1998 New Energy Law and the Federal Anti-Trust Law were among the primary legal tools designed to make the electricity and gas markets more competitive. The laws also aligned German laws with EU directives by emphasizing cross border electricity and natural gas trades. The law also prohibited exclusive concession contracts and demarcation agreements[16] in the electricity and gas markets (Schleich, et. al., 2002).

The flexibility of prices in a liberalized market environment helped the electricity market in Germany adjust to different needs and provide choices. Liberalization also increased the participation of foreign firms in the German energy market, increased the supply of energy, and decreased energy prices.

In addition to market liberalization, Germany reformed its energy laws by strengthening the Feed-In-Price[17] policy to support the promotion and use of renewable energy. The Electricity Feed Act of 1991 gave legal backing to the operation of Feed-In-Prices as a subsidy to offset energy companies' high cost of providing renewable energy. Payment was to be continued until the share of such

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[16] This gave national joint ventures, regional suppliers and municipal enterprises the means to demarcate supply zones from those of other power supply companies. This created monopolies and made it difficult for independent power generators and suppliers to compete in some supply zones.

[17] This refers to a levy on energy prices charged by the government on energy companies as their contribution towards the promotion of renewable energy. Germany used this concept to support renewable energy use.

renewable energy reached 5% of electricity capacity. The amount of the subsidy to renewable energy producers varied according to the size of the electricity grid (Schleich, et al., 2002). Effective operation of the Feed-In-Prices Act is expected to lead to a 10% renewable energy contribution to power production by 2010, from its current 2% (Schleich, et al., 2002). If effective, the Act will also help reduce CO_2 emissions by 20-30MtCO_2 over the same period.

Liberalization of energy markets in Germany resulted in falling energy prices and revenues from the Feed-In-Price. To address this decrease, the German legislature passed the 2000 Renewable Energy Source Act. The objective was to maintain Feed-In-Prices against continuous fall in energy prices. This Act fixed Feed-In-Prices for 20 years. It exempted from payment renewable companies in which the government owned at least a 25% share. The Act also allowed Feed-In-Prices for wind, photovoltaic, and biomass energy sources to fall over time. The Renewable Energy Source Act is projected to cost energy companies about €1.23 billion compared to € 0.67 billion under previous laws, and it will also increase electricity prices by 0.05 to 0.1e/kWh (RWE, 2003). The proportion of the Feed-in-Price and other taxes as a share of electricity prices in Germany continued to increase between 1998 and 2003 (figure 4-1).

Another policy objective of the German legal framework was the promotion of energy efficiency.[18] The Energy Savings and Labeling Act of 1997 was directed towards efficiency in the market for household appliances. The Act also required proper insulation of buildings to prevent heat loss and ensure heating costs savings (Pfaffenberger & Otte, 2000). "The Act" operated within the European Commission framework and required all German household appliances to be labeled with energy consumption information and GHG emissions information. The 1990 Federal Act on Immission[sic] Protection and its 2000 amendment focused on the use of cogeneration[19] by electricity plants with more

[18] This means the provision of energy services with minimum energy use and costs

[19] Cogeneration refers to the process of reusing the heat produced during electricity generation instead of expelling it as waste. For example, the combined heat and power source (CHP) technology is designed to produce both heat and power for industrial and domestic heating purposes.

than 500 kW (Pfaffenberger & Otte, 2000). It obliges operators of energy plants to internally use their waste heat or donate it for third party use, if it is technically possible and reasonable to do so (Stagnierender, 2000).

4.1-3 Achieving the Objectives at a Lower Cost Comparatively

In addition to liberalization, German subsidies to coal and nuclear energy producers also helped push energy prices to artificially low levels. This had the effect of increasing energy use and GHG emissions. For example, the cost of generating electricity fell by €5.8 billion in 1999 (Stagnierender, 2000). The political influence of the coal workers union and the low carbon emissions from nuclear energy encourages these subsidies. The German government, mindful of the effects of falling energy prices on the demand for energy and increased GHG emissions, fixed the Feed-In-Price (discussed under legal reforms) to regulate the further fall in electricity prices. Other policies implemented to help reduce GHG emissions include flexible loan support with zero percent interest rates and subsidies up to 40% of investment cost for renewable energy production (Schleich, et al., 2002).

According to 2003 estimates, Germany's efforts to increase renewable energy use through flexible loan guarantees are producing results. The country currently produces 10,000 gigawatts of wind energy; this is enough electricity power to supply the electricity needs of Berlin and surrounding areas. This approach to promoting renewable energy is being extended to other areas of the country that have wind potential (www.germany-info.org/relaunch/politics.html).

Germany also achieved energy cost savings and GHG emissions reduction through vertical and horizontal integration of energy companies. Companies reorganized their operations in a bid to cut costs, invest in energy technologies to reduce GHG emissions, and reduce inefficiency. The number of energy companies shrank from about 3,500 in the 1950s to 1,000 in 1999 (Schleich, et al., 2002). Despite the cost saving advantages of increased productivity and employment in marketing and energy services sectors, integration increased

unemployment overall; 67,000 jobs were lost between 1991 and 1999 (German Electricity Association, 2000).

Other policies aimed at reducing energy use and costs to the German economy include changing building construction regulations for heat, air conditioning, and fire safety measures (Pfaffenberger & Otte, 2000). The action on heat insulation aims to limit annual heating demands for new buildings and the re-construction of existing buildings to reduce their future energy demands. For example, the average amount of energy used for heating houses in Germany was 220kWh/ per m^2 /yr. of usable space in 1984, but fell to between 55 and 100kWh/m^2 /yr. by 1998 (Pfaffenberger & Otte, 2000). The reduction in the use of energy for home heating also translates into GHG emissions savings. (EU Statistics, 2004).

Also 'eco bonus,' a tax support for residential owners who invest in energy savings[20] was introduced in 1997 (Hensing, et al., 1998). Under this program, home owners get 500.00 DM/yr. for a maximum of 8 years for the installation of heat pumps or solar and heat recovery plants, or 400.00 DM/yr. for the construction of low energy houses. It is estimated that the 'eco bonus' for energy saving led to about 50% decrease in energy consumption in participating homes (Pfaffenberger & Otte, 2000).

4.1-4 Incentives for Innovation

Another objective of the German policy framework was the creation of a transparent market mechanism to stimulate entrepreneurial drive and innovation. The Negotiated Third Party Access (NTPA) a body comprising the Federal Association of German Industry (BDI), the Association of Industrial Energy and Power (VIK), and the German Electricity Association (VDEW) was formed and made responsible for setting voluntary transmission tariffs and conditions for operating electricity grids. The NTPA introduced an optimal transitional single

[20] These energy savings methods include heat insulation, renovation of windows, and low temperature boilers.

buyer system for electricity. This system was to continue until the government decided otherwise (Schleich, et al. 2002).

Emissions trading, the most market friendly Kyoto Protocol concept with the potential to reduce GHG emissions at a relatively low cost, received mixed reaction in Germany. The country resisted the concept during the Kyoto negotiations, because, according to Dr. Merkel, then Environment Minister, emissions' trading was based on overly optimistic projections of its effectiveness to reduce GHG emissions (Leonard et al., 1998). Most industries, on the other hand, favor emissions trading but prefer flexible GHG emissions reduction instead of fixed caps on trading, because they see a comparatively lower cost in flexible emissions trading (Dooley, 1999). Government and private sector attitudes toward emissions trading changed in 2001 when the Environment Minister, Jurgen Triton, said *"emissions trading can contribute positively to climate protection"* (London, 2001). A CO_2 emissions trading simulation undertaken by Deutsche Ausgleichsbank (DtA) and other companies in Hessian (a federal state in Germany) recorded promising results. The simulation suggested about 1.31 million tons of CO_2 emissions reduction during emissions trading. This result encouraged the private sector and the Ministries of Environment, Agriculture, and Forestry to expand support for emissions trading (Schweer, 2002).

Other micro emissions trading programs include Hamburg Utility (HEW), which sells emissions rights to a Canadian generator (Schleich, et al., 2002). Reconstruction Loan Corporation has also set up two funds to stimulate the use of the Kyoto Protocol's mechanisms on GHG reduction. One of the funds helps with investments in clean development mechanisms (CDM) projects, while the other encourages small and medium size companies to take part in national and international emissions trading.

In the area of fiscal policy incentives, Germany introduced an ecological tax in April 1999 (Schiffer, 1999). This policy imposed a tax on fossil fuel energy consumption to reduce GHG emissions. Tax revenues are used to subsidize renewable energy and promote employment. By making fossil fuel energy

expensive, the tax made renewable energy more competitive and provided an incentive to increase renewable energy use. The ecological tax policy includes:
The introduction of a general tax of 1e/kWh on electricity consumption in 1999, and a 0.26e/kWh increase for four consecutive years. Table 4-1 shows higher taxes on fossil fuel use in electricity from 1998-2003. Also, tax increases for heating oil for industry were higher in Table 4-1 compared to electricity and natural gas taxes (Schiffer, 1999).

The German tax policy is also designed to encourage renewable energy use and GHG reduction. For example, taxes on public transport electricity are halved, because public transport is considered to be environmentally friendly. Also, manufacturing, agriculture, and forestry sectors that incorporate environmentally friendly energy practices pay a reduced rate of only 0.2e/kWh, 0.41e/litre, and 0.033e/kWh for electricity, oil, and gas, respectively. These rates apply to firms with an annual electricity consumption of more than 50MWh (Schleich, et al., 2002).

Germany also uses 'green electricity pricing' as an incentive to promote renewable energy. This is done through differentiating the market and catering to customers willing to pay premium prices for energy generated from renewable energy technologies [21] or cogeneration. Common among such pricing is a 'green tariff' currently costing about 30% more than standard rates. The market share is still below 1%, but is thought to have a 5-10% potential (Dreher, et al., 2000).

To accelerate the promotion of renewable energy under the New Renewable Energy Source Act of 2000, a €102 million investment at 0 % interest rates and price reductions were offered by the Reconstruction Loan Corporation for the construction of 100,000 residential photovoltaic roofs, beginning in 1999. This program is aimed at supporting the installation of an additional 300MW of electricity capacity from photovoltaic in addition to the existing 50MW. It has an average capacity of 3kW per unit (RWE, 2003).

[21] These include: wind power, solar thermal, biomass, and photovoltaic.

4.1-5 Effects of Policies on Different Sectors of the Economy

The number of utility companies operating in Germany by 2005 will be only half the number at the beginning of liberalization in 1998 (IEA, 2000). This reduction in energy companies is the result of competition, mergers and acquisitions, and the elimination of inefficient energy providers.

Cogeneration did not seem to thrive in the German electricity sector, partly because of the intense competition that followed liberalization. The only plants that were competitive under the liberalized market conditions were the combined heat and power plants[22] (CHP). This technology produces electricity and heat for district heating purposes. To help cogeneration to survive the German government provided temporary support under KWK-Vorschaltesetz, 2000 (Dreher et al., 2000). Under this plan, municipal power producers receive a subsidy of 4.6e/kWh from the grid operator if the CHP electricity source accounts for 25% of its capacity and at least 10% of the total power production of the utility. This support is designed to decrease by 0.26e each year (Schutz der Kraft-Wärme-Kopplung, 2000).

The low carbon emissions and direct marginal cost make nuclear energy important in any economical GHG emissions reduction plan. The politics of the safety of nuclear waste in Germany and the pressure from institutions that advocate the phase out of nuclear energy constrain extensive use of nuclear energy. Politically motivated regulations advocated by the German Green Coalition parties in 1998 included the gradual phase-out of electricity produced from nuclear plants by 2021. This policy was in response to concerns from the public and environmental groups about the potential costs and safety of nuclear energy, especially the handling of the waste, after the Chernobyl disaster (Runci & Dooley, 2000). The federal government's support for research into nuclear fission continues to fall as a result. Negotiations between the government and the nuclear industry in 2000 resulted in a lower quota of 2,500TWh of nuclear electricity to be provided by 19 firms until 2021 (Schleich, et al., 2002).

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[22] The burning of sawdust to produce heat or power on the basis of steam turbines or motors

Phasing out nuclear energy may be feasible politically, but it poses economic and environmental challenges. Table 4-3 indicates Germany must find ways to replace 12.8% of its energy supply, if the phase out of nuclear power is effected. Both the economic costs of importing energy and the security concerns of energy dependence will increase. Moreover, substituting cheaper coal for nuclear will increase the economic cost of subsidies and work against the GHG reduction policy.

Subsidies to German coal producers in the 1990s were between 5-6 billion Euros; the subsidies are expected to decline to about 2.8 billion Euros in 2005 (Schiffer, 1999). This poses a huge challenge for the goal of GHG reduction and renewable energy promotion (Schleich, et al., 2002). Consumer displeasure about the effects of the subsidies on tax burdens and GHG emissions forced the German government to propose a reduction in the subsidy (IEA, OECD, 1998). The government continues to maintain its subsidy agreement with steel workers because steel production in Germany uses about 20% of cheap hard coal (Vrolijk, 2000).

4.1-6 Global Positioning Purposes

Flexible mechanisms are among the alternative policy options being used by Germany to promote renewable energy. Activities implemented jointly (AIJ) include establishing a coordination office, financing evaluations, and research programs in different countries. The objective is to provide "a cross fertilization of ideas" on research and development and help position Germany as a future global leader in renewable energy technologies. These overseas investments also count towards Germany's emissions reduction credits under clean development mechanisms (Schulz, 2000). Some of the international projects developed are located in Russia (2), the Czech Republic, Latvia, Jordan, and Zimbabwe. Together these projects are expected to reduce GHG emissions by 8.65 $MtCO_2$ (Schleich, et al., 2002).

Germany also participates in a variety of international co-operations on environmental matters. Currently, the Executive Director of the United Nations

Environment Program responsible for the Kyoto Protocol is a German (Klaus Topfer). Bonn is also the home to the UN Secretariat of the Convention on Climate Change (EEA, 2003). These high offices in Germany give the country a front row seat on Kyoto Protocol and climate change policy formulation and implementation

4.1-7 Meeting European Union Membership Requirements

Germany demonstrated its support for a strong EU environmental policy by its constitutional amendment in 1994, making environmental protection a national objective. The decision to reduce GHG emissions by 21% was also a positive step in the same direction. In addition, Germany's Energy Labeling Act of 1997 conforms to EU wide energy labeling reforms. Germany is currently working with industry groups to ensure that the Energy Labeling Act is incorporated in business strategy and goals. For example, Germany's electronics giant (AEG) planned to reduce the average energy consumption of its home appliance products by at least 25% between 1995 and 1999 (Runci, 2000).

Germany has also adopted an EU transport sector target for car manufacturers. This policy is directed towards reducing auto-related CO_2 emissions by 90 million tons of CO_2 equivalent in 10 years. Table 4-3 shows a projection of energy use by 2020 and the allocation to various sectors. The country's GHG reductions policy will be on target, and Germany's desire to become a global leader in a low carbon economy will be greatly enhanced if these targets are met.

To ensure conformity with, and convergence of, EU-wide energy standards, and GHG emissions reduction policy, Germany implemented an electricity tax on fossil fuels for domestic electricity generation, instead of directly taxing fuel imports. Most European countries do not tax fuel imports; therefore the use of a tax on fuel imports would increase the production cost of German energy providers and make it difficult for German energy producers to compete in the foreign market. It would have also resulted in double taxation if

both imported fuel and the electricity from such fuel imports were taxed (Schiffer, 1999).

The political re-unification of Germany in 1990 also played an important role in achieving the ambitious GHG emissions reductions target. Estimates suggest that about 50% of all reductions in GHG after 1990 were achieved under re-unification. The other 50% reduction was through deliberate and conscious policies (Schleich, et al. 2000). The emissions reduction credits achieved under German re-unification "wall fall profit" are part of the Kyoto Protocol's implementation mechanisms called joint implementation.[23] Following re-unification, the power plant pool in former East Germany was restructured and upgraded. New lignite, gas, and hard coal power plants were constructed, while old, inefficient power plants were closed down. This process improved technical efficiency. Investments in the power industry of former East Germany lead to 0.5% average annual improvement of energy efficiency in the power plants sector from 1997 to 2000 (ESSO, 1997).

Electricity consumption in Germany before unification was about 550 billion kWh in 1990, but electricity consumption nation-wide fell to 545 billion kWh in 1997 after re-unification (Pfaffenberger & Otte, 2000). Germany, under Article 6 of the Kyoto Protocol, qualifies to claim emissions reduction credits for such investments in the power industry of former East Germany.

4.1-8 National Security Objectives

The fear of nuclear energy generated by the Chernobyl nuclear disaster, and also the contribution of fossil fuels to GHG emissions increased Germany's desire to find energy alternatives that will promote safety and reliability (Dooley, 1998).

The cost disadvantage of the promotion of renewable energy compared to fossil fuels called for a shift in the German approach to renewable energy promotion from an outward(promoting renewable energy abroad) to

[23] Under Article 6 of the Kyoto Protocol, any party in Annex 1 may acquire from any other country, emissions reduction units resulting from investments in the country's projects aimed at reducing anthropogenic emissions by source in any sector of the country's economy.

inward(promotion or renewable energy at home) (Schulz, 2000). Renewable energy policies of the 1970s were designed for export to developing countries without regard for the development of efficiency and demand capacity at home. It was argued that an inward policy on renewable energy would put local needs first, help develop the competitive edge in new technology at home, and enjoy first mover advantages associated with such renewable energy technology. Such a policy could also help Germany become less dependent on foreign sources of oil and reduce GHG emissions.

Germany is currently developing research into hydrogen fuel cells. The national research and development budget for this technology in 1997 was $10 million (Runci & Dooley, 2000). One advantage of hydrogen is efficient storage.

Chapter Five

Map of Poland

5.1-1 Overview of Poland

Poland covers 312,658 sq. km, 8,220 sq. km of which is covered by sea. It has a population of 38,625,478 (July 2002). The country was partitioned in 1772 between Russia, Prussia, and Austria and became independent in 1918, only to be overrun by Germany and the Soviet Union in World War II. Poland became a Soviet satellite country after World War II, but one that was comparatively tolerant and progressive. Labor turmoil in 1980 led to the formation of an independent trade union called "Solidarity." This union quickly became a political force, and by 1990 had swept parliamentary elections and the presidency. Drastic measures were pursued by the new government in the 1990's to change the political, economic, and institutional structures of the country and transform its economy into one of the most progressive in Eastern Europe.

Poland's economy is currently in transition. Markets are being liberalized, and prices are becoming transparent and competitive. In 2002 Poland's GDP was $362.1 billion, or $9,500.00 per capita, and a growth rate of 1.2%. GDP contribution by sector is: agriculture 4%, industry 35%, and service 61 % (CIA, 2002).

Coal, sulfur, and natural gas are among the main natural resources. Nearly 97% of Polish electricity production is from fossil fuels (table 5-2). Coal contributed 78% and 75% of the fuel mix in 1989 and 1996, respectively, while renewable energy contributed only 1.6% and 4.8% (Sobolewski & Zylicz, 2000). As a result, air pollution remains a serious concern, mainly due to sulfur dioxide and other emissions from coal-fired power plants. Coal emissions also add to particulate matter and mercury which has caused extensive forest damage (Ministry of Environment, 1990). Total economic loss resulting from environmental degradation in 1998 was estimated at $3.4 billion. This loss included soil erosion, air pollution, and public health costs (Sobolewski & Zylicz, 2000).

The Kyoto Protocol classifies Poland as an Annex A country. Poland ratified the Kyoto Protocol in July, 2002 (Polish Parliament, 2002) and accepted the mandate of 6% GHG emissions reduction below 1990 levels by 2012 (UNFCCC, 1997). This was a necessary step for EU membership because the EU has agreed to implement the Kyoto Protocol provisions (EU, 1998).

Poland is determined to reform its political and natural environment and embrace market liberalization as an integral part of its energy policy. Embarking on such reforms can have twofold benefits: it will make Poland one of the Eastern European leaders in market approaches to solving environmental problems, and it will strengthen Poland's EU environmental record.

5.1-2 Legal Reforms

By ratifying the United Nations Framework Convention on Climate Change (UNFCCC) in July, 1994, Poland qualifies to use environmental reforms and GHG emissions reduction programs that began in 1988 as relevant emissions reduction credits for its Kyoto Protocol requirements (UNFCCC, 1995). As part of the UNFCCC reforms, Poland committed to preparing and publishing periodic national inventory repots showing the effects of measures taken to reduce GHG emissions. Poland's Kyoto Protocol commitment as a result is 6% reduction in emissions from a Kyoto basket of GHG from 1988 levels by 2012 (EEA, 2003).

The Energy Law of 1997 was passed to accelerate reforms began in 1988, to adjust the country's energy laws towards meeting EU membership, and the Kyoto Protocol requirements (Poland's Energy Law, 1997). Reforms in 1997 were focused on restructuring Poland's energy mix. Poland's Energy Law defined the general principles underlying Poland's national energy policy, including heat, and the operation of private energy enterprises. The Law also determined various organizations responsible for the administration of fuel and energy economy (Poland's Energy Law, 1997).

The Law also reflected the country's legacy of central planning by combining old command and control structures with new liberalization policies in both energy and environmental policies. Article 9.4 of Poland's Energy Law mandates the Energy Minister to require electric and heat energy enterprises to purchase energy from renewable sources. Article 9.4 is neither well defined nor stringent. It only states that renewable energy purchases by energy enterprises must be increased from the current 1.4% to 7.5% of their electricity supply by 2010. Most energy companies are not complying with this requirement because there are no defined penalties for non- compliance (Gierulski, 2002). Many policy analysts are also skeptical about Article 9.4. They consider it a political tradeoff between the environment and the domestic coal producers and distributors (Sobolewski & Zylicz, 2000).

Poland also introduced the "polluter pays[24]" principle as part of the Environmental Protection Act, 1991 and its amendment in 2001 into the Environmental Protection Law Act, to internalize the cost of all pollution and also assess and regulate the impact of various activities on the environment (Wiszniewska, et al., 2002). These laws required sources of pollution to apply for and maintain pollution permits. The permits were used to assess pollution taxes by setting source-specific ceilings for the Kyoto basket of GHG. Pollution charges are imposed on the emissions discharged by each permit. Penalties of up to 10 times the tax rate are imposed if the GHG emissions exceed the permit allocation. Since 1991, charges have been increased 20 times (Anderson & Fiedor, 1997). Tables 5-2 and 5-3 show charges on specific air pollutants and their collection and efficiency rates, respectively.

Other reforms introduced in Poland include the National Allocation Plan for CO_2 emissions allowances. This CO_2 allocation plan was designed to conform to the EU requirements in directive 2003/87/EC of the European Parliament and Council. The directive establishes a scheme for GHG emissions allowance trading within the EU community (Min. of Environment, 2004). Directive 2003/87/EC, is designed to create the conditions for an effective fulfillment of emissions reduction commitments in the EU, through an efficient market for GHG emissions allowance with the lowest possible reduction in economic development and employment (Min. of Environment, 2004). The development of the National Allocation Plan in Poland also reflects the expectation that the country's participation in an EU-wide emissions trading will be financially rewarding. According to the Polish Parliament, the 30% GHG emissions reduction achieved so far from the country's environmental reforms since 1988 can result in an estimated $1 billion in an EU- wide emissions trading that will begin in 2005 (Polish Parliament, 2002).

[24] This policy ensures that pollution agents and sources are charged for the pollution. This principle internalizes externalities, reduces the social cost of clean ups, and fosters market efficiency.

5.1-3 Achieving the Objectives at a Lower Cost Comparatively

Achieving the objective of emissions reduction and renewable energy at low costs requires creative policy initiatives. Poland's interest in a market based approach to solving environmental problems led to deregulation and privatization of energy institutions to promote institutional effectiveness (Sobolewski & Zylicz, 2000).

Initiatives introduced included emissions trading. Emissions' trading was approved in principle by the Polish Parliament in July, 2002, as a market-based approach to help reduce the cost of emissions reduction and encourage meeting Kyoto Protocol standards. The Polish Environment Minister's task was to develop models of possible emissions trading scenarios (Polish Parliament, 2002).

Poland also introduced district heating and allowed it to be part of the deregulation process and in the promotion of renewable energy use. District heating in Poland was mostly used in the local communities and played an important role in local heating across Poland. For example in 1993 ownership of the Municipal Thermal Energy Enterprise (MPEC), one of the largest in Poland, was transferred from government control to the district of Wroclaw (the fourth largest city in Poland) (Sobolewski & Zylicz, 2000).

The privatization of energy institutions improved competition and efficiency in energy use. Meters were introduced into apartment complexes connected to a distribution grid, variable rates were charged for energy consumed according to the meters measurement. Through such competitive pricing of electricity, MPEC achieved a high level of efficiency in energy use. About 30% of MPEC's thermal loss was attributable to poor insulation. Energy companies also became aggressive about preventive maintenance. This helped to reduce hot water loss to about 0.64% of the total water circulated throughout the system per hour in 1995 (Manczyk, 1998). Improved efficiency in energy use in Poland will translate into GHG emissions reduction (Sobolewski & Zylicz, 2000).

In 1992, the government abolished the centralized allocation and administration of coal mining, partially liberalized coal prices, and began a gradual reduction of coal subsidies. These policy changes resulted in a relatively

free coal market. Coal prices rose by 13%, raising strong objections from coal consumers. The government also began restructuring the coal mining industry by establishing ten independent and competing coal mines, some coal wholesalers, and an export agency, to improve efficiency and eliminate waste (www.countrystudies.us/poland/55.htm).

These reforms initially created problems for the coal industry, but helped achieve GHG emissions reduction. For example, 56 of the 67 coal mines in Poland declared losses when government subsidies fell from 9.1 to 5.9 billion Zloty. Despite the price increases resulting from the removal of subsidies, the policy resulted in overall government cost savings of about 3.2 billion Zloty in 1992 (Sobolewski & Zylicz, 2000). This development in the Polish coal industry contributed to GHG emissions reduction and improved competitiveness of the goals.

5.1-4 Incentives for Innovation

Poland's EU membership requires energy policy reforms to align them with EU standards (EU, 1999). Despite its historic reliance on coal energy and the resulting high emissions, Poland decided that improving its environment, reforming energy policy and obtaining its current EU membership will enable it to reap the future benefits of EU-wide emissions trading (Polish Parliament, 2002).

The central government mandated its departments to create and use appropriate incentives to achieve the objectives of emissions reductions and renewable energy use. The Ministry of Environmental Protection was responsible for limiting emissions through creating measurable standards, while the Finance Ministry was responsible for the creation of special taxes on energy carriers and investment tax breaks.

Progressive leadership after 1990 elections also bolstered Poland's reform efforts. The argument for market forces determining the level of abatement, once externalities are internalized through taxes, was appealing to the liberal-minded administrators who ran the government in the 1990 s. The Machiavellian belief was that leadership at that time knew that any attempt to unilaterally elevate

pollution taxes to painful levels would be a political failure (Sobolewski & Zylicz, 2000). Despite these domestic realities, the desire to reform the country's image as one of Europe's most polluted countries and qualify to join the EU was an overriding objective. The progressive government and legislature cooperated in a concerted effort in the 1990 s to resist political pressure from the main interest groups (the coal mine unions and business interests groups) and implemented legal and economic reforms (Anderson and Fiedor, 1997).

GHG emissions tax rates and levies were based on the marginal principle,[25] although in some instances they were set higher to serve as incentives for polluters to invest in emissions reduction measures. Revenues from the charges were reinvested in efficient coal plants and technologies. The charges were also reviewed periodically and adjusted for inflation often (Anderson & Fiedor, 1997). Over the past decade, policy makers' efforts at introducing and strengthening environmental policy including the use of permits, fines and charges have incited polluters to reduce emissions, and pay attention to negative externalities. Part of this approach consisted of closing down the worst sources of GHG emissions. Between 1992 and 1998, the State Environmental Inspectorate shut down 136 plants (Wajda, 2000). More importantly, this *"get tough approach"* with polluters has become an indirect incentive for polluters to invest in environmental protection equipment. In 1998 for example, total investment expenditure for environmental protection in Poland was 9 billion Zloty (Central Statistics Office, 2000). Annual environmental investments continue to increase in Poland (figure 5-1). The State Environmental Inspectorate also reported that between 1988 and 1998 emissions by the "List of 80[26]" including dust particles, sulfur compounds, nitrogen compounds and carbon dioxide decreased by 74%, 55%, 36% and 34% respectively (Peszko & Lenain, 2000).

Poland's market liberalization efforts - reduction in coal subsidies and pollution charges - also encouraged fuel switching. Domestic natural gas

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[25] Setting the tax equal to the marginal damage helps remove any disruptive effects of the tax on the market's ability to allocate energy efficiently

[26] This list contains the worst polluters in Poland, selected by the Ministry of Environment. The Criteria includes pollution discharges in excess of environmental standards.

production and use began to outstrip oil imports by 1991 in an effort to promote energy security, reduce GHG emissions, and reduce dependence on coal. The increase in domestic natural gas exploration saved Poland from importing approximately 7 billion cubic meters of gas from the former Soviet Union annually (Wisniewski & Rogulska, 1998).

Poland has also used fiscal policies to stimulate the use of environmental technology and renewable energy. Power generators were exempted from income taxes for 5 years, if they produced energy from renewable sources. Farmers using renewable energy received tax rebates, loans and grants for up to 15 years. Other incentive packages included price guarantees for producers of renewable energy by the Ministry of Trade and Industry and premium pricing for up to 5MW of electricity produced from renewable sources. To further encourage renewable energy, the Ministry of Trade and Industry, under Article 9.4 of the new Energy Law of 1997, guaranteed that producers of small hydro and wind power will only pay 15% of the final price of energy as taxes, compared to the over 30% for non-renewable energy (MoIT, 1996).

Collaboration between the government of Poland and some non-governmental organizations on renewable energy incentives led to grants totaling $10 million from 1990 to 1996, funding 720 projects of the Eco and Environmental funds (NCSUNFCCC, 1998). Even though this support is meager compared to the needs in Poland, it is a positive incentive signal.

Due to the history of central planning and its ineffectiveness in promoting innovation, incentive packages like competitions organized annually by the Eco Fund for the best district-heating project were used to help promote creativity in the use of renewable energy methods and protect the environment. The best four district projects from each year's competition qualified for Eco Fund financial support (Sobolewski & Zylicz, 2000).

5.1-5 Effects of Policy on Different Sectors of the Economy

Poland's task of controlling GHG emissions from coal fired power plants was an uphill battle. The use of the "polluter pays" principle, even though successful, was not without problems. Combustion sources were dispersed across the country, making it difficult to effectively control emissions by using levies and pollution charges. In addition, the debates on reforming policy instruments and integrating pollution monitoring for large polluters are obstructed by lobbying from strong interest groups and industry (Peszko & Lenain, 2000).

Despite Poland's achievement in emissions control, concrete policy steps that could translate into a national movement towards renewable energy were still lacking, especially at the district levels (MoIT, 1996). This is due in part to the resistance to moving away from coal, which is abundant in Poland. The lack of effectively decentralized institutional infrastructure at the district levels caused by prolonged periods of central planning also retarded renewable energy development (www.countrystudies.us/poland/25/htm).

5.1-6 Global Positioning Purposes

Desiring to become a regional leader on environmental issues in Eastern Europe, Poland embraced Western models of development that emphasized market solutions to environmental protection and renewable energy. Poland aggressively reformed its legal system and economy accordingly.

Poland currently emits about 32.3% less GHG according to Kyoto Protocol standards (table 7-1). This savings could translate into big profits for Poland under emissions trading (Polish Parliament, 2002). According to Stanislaw Zelichowski, Polish Environment Minister, "*Poland currently has a "deficit" of about 100 million tons of carbon dioxide annually which can be sold for about $10 per ton; this money ($1 billion annually) can be injected into the economy and the improvement of the environment.*" Poland's acceptance of emissions trading is forward looking and a savvy attempt to position the country for the EU-wide policy of emissions trading scheduled to take off in 2005 (Polish Parliament, 2002).

To the extent that Poland has ratified the Kyoto Protocol and is advancing the country towards emissions trading, it can be argued that measures taken thus far are helping Poland to reduce emissions. Revenues from pollution charges provide a reasonable public share in environmental project financing for the following: education, research, monitoring equipment, loans, grants, and interest subsidies on commercial loans (Anderson & Fiedor, 1997). This can help Poland become an environmental leader in Eastern Europe.

5.1-7 Meeting European Union Membership Requirements

The need to adjust domestic prices of energy to internalize all externalities is an important step to reducing GHG emissions and achieving Poland's Kyoto Protocol requirements. But this policy is not well received locally (McGowan, 2000). Politically and socially, the country has not reached a consensus on how to pursue environmental protection. Political parties are split; some argue that environmental protection leads to economic stagnation and jobs loss; others argue environmental protection leads to economic growth. (Sobolewski & Zylicz, 2000). Public attitudes are also divided along similar lines. A 1992 poll found only 1% of Poles cited the environment as the country's most serious problem, although 66% rated their current environmental conditions as "very serious." In contrast 72% cited economic issues as the country's most serious problem (www.countrystudies.us/poland/25/htm).

Even though environmental protection and GHG emissions reduction were not public priorities in Poland, according to this poll, providing jobs was. This opening was effectively used by the country's leadership to push through environmental protection, arguing that it is necessary for job creation. This policy approach was successful because it was generally believed that EU membership will result in investments and jobs in Poland (Polish Parliament, 2002). The difference between EU policy and member country objectives calls for a delicate political and economic balancing act in the pursuit of local environmental policy.

5.1-8 National Security Objectives

Coal traditionally has dominated the energy mix of Poland. It comprised 78%, 75%, and 61.1% in 1989, 1996, and 2001, respectively, while oil comprised 22.5% in 2001 (IEA Statistics, 2001). This creates joint and different national security concerns (pollution and oil supply shocks). Reducing dependence on such fuels and successfully switching to renewable sources of fuels will reduce emissions from GHG, protect the environment and also help reduce the $3.4 billion annual economic loss from environmental degradation (Sobolewski & Zylicz, 2000).

Poland receives most of its crude oil supplies from Russia and the Middle East. History and current events suggest that dependence on the Middle East for oil can be problematic in the long term due to instability in the region. As a result, Poland hopes to improve energy independence by increasing the use of renewable energy and clean coal technologies (Ministry of Environment, 2004). According to the Ministry of Trade & Industry (Gierulski, 2002), Poland can achieve a 14% use of renewable energy by the year 2020. This can be done in phases: a 3% increase in renewable energy by 1997, 5% increase by 2005, 7.5% by 2010, and 10.5% by 2015.

Geothermal energy's estimated potential is about 117-263 PJ (Petra 10^{15} joules) per year (Sobolewski & Zylicz, 2000). In 2001, geothermal energy contributed 4000 Ktoe out of the total of 80728,000 Ktoe (IEA Statistics, 2001). The geographical location of Poland gives it a potential to generate about 980-1100kWh (kilo watt hours)/m^2 of solar energy per year. The downside to this is that photovoltaic cells converting solar radiation to electricity are expensive and minimally used in Poland (Gierulski, 2002). Increasing renewable energy use and successfully controlling CO_2 extensive coal use can help Poland increase its energy security.

Poland, like Germany, uses fiscal policy and regulations in its GHG emissions reduction and renewable energy policies, but unlike Germany, Poland's proposed emissions trading program is an attempt to introduce market mechanisms into its policy approaches to GHG emissions reduction.

Chapter Six

Map of Britain

6.1-1 Overview of the United Kingdom

England has existed as a unified entity since the 10th century. The legislative union of Great Britain and Ireland was implemented in 1801, with the adoption of the name United Kingdom (UK) of Great Britain and Ireland. The Anglo-Irish treaty of 1921 formalized the partition of Ireland. Six northern Irish counties remained part of the UK as Northern Ireland and the current name of the country- the UK of Great Britain and Northern Ireland- was adopted in 1927. The country has a population of 59,778,002 (July, 2002), population growth rate of 0.21% and covers 244, 820 sq. km (CIA, 2002).

The UK in 2002 had a GDP of $1.52 trillion, per capita GDP of $25,300, and a GDP growth rate of 1.6%. Production as a percentage of GDP by sector is as follows: 1%, 25%, and 74% for agriculture, industry, and service, respectively (CIA, 2002).

The UK's natural resources include coal, petroleum, natural gas, tin, limestone, iron ore, salt, clay, chalk, gypsum, lead, silica, and arable land. Environmentally, the UK is known for its leadership role in reducing GHG emissions in line with Kyoto Protocol standards (CIA, 2002). It ratified the Kyoto Protocol on Climate Change on May 31, 2002 and continues to explore new ways to reduce GHG emissions. The country has committed to a 12.5% GHG emissions reduction from 1990 levels by 2012 under EU bubble target negotiations. The UK also hopes to achieve a domestic goal of 20% GHG emissions reduction within the same period (Steen & Vrolijk, 2002).

Coal, natural gas, and oil provide most UK energy. Revenues from the sale of these energy sources account for about 10% of GDP, one of the highest shares for any industrialized nation (Jasinski, 2000).

The quest for energy security has been at the heart of most of UK's energy policies (Dooley, 1999) and led the Conservative government of Margaret Thatcher and earlier governments to support accelerating nuclear electricity generation. Table 6-1 shows the growth of nuclear power in UK's energy mix. Public concerns about the disposal of nuclear waste and its environmental effects led to a renaissance of renewable energy as an alternative to nuclear energy.

The government therefore created the Research, Development, and Demonstration Program, (RD&D), a support group dedicated to the development and growth of renewable energy in the UK.

Renewable energy currently accounts for 2% of UK's production, but the country planned to increase this to 5% by 2003 and 10% by 2010 (Runci, 2000). The 2003 target was not realized. Instead, renewable energy contributed only 2.3% of electricity in 2003 (www.dti.gov.uk/public.html).

To achieve the country's Kyoto Protocol emissions reduction allocation, the government targeted the domestic energy mix for diversification because electricity consumption comprises 30% of UK's energy production (EU Statistics, 2004). The government believes that improving efficiency in electricity production and use would help reduce GHG emissions.

6.1-2 Legal Reforms

Changes in the UK's energy policy began with the Electricity Act of 1983 and its amendment in 1989. This legislation promoted deregulation in the energy sector, the competitive pricing of energy, and the production and use of renewable energy, as policies that could help reduce GHG emissions (Steen and Vrolijk, 2002).

Deregulation was designed to remove barriers to competition and improve efficiency in the electricity market. To achieve this objective, the deregulation was phased in over the course of a decade, beginning in 1990 with privatization and competition for electricity generation, marketing, and the use of supplier choice for large industrial firms (Chesshire, 1996).

The Electricity Act also created the Non-Fossil Fuel Obligation (NFFO) and the Fossil Fuel Levy (FFL), under sections 32 and 33 of the Act, for the promotion and use of renewable and nuclear energy. The NFFO required each Licensed Supplier of Electricity (RECs) to purchase a percentage of electricity from both nuclear and renewable energy sources.

The FFL is a tax imposed on all fossil fuel producers and suppliers. Tax revenues were recycled as subsidies to energy companies for the additional costs incurred in producing and selling nuclear and renewable energy (Jasinski, 2000). The objective of the FFL was to reduce the cost involved in promoting the production and use of both renewable and nuclear energy. Making such energy affordable will, over time, reduce the proportion of fossil fuels in UK's energy mix and also its GHG emissions. Table 6-2 shows the revenues from the FFL.

The FFL generated criticism because part of its revenue was used to subsidize nuclear energy. According to Newberry, *"Subsidizing the use of nuclear energy in electricity, amounts to subsidizing the production of nuclear waste"* (Newberry 1993). UK's support for nuclear energy was rooted in the assumption that nuclear energy could help reduce GHG emissions at a lesser cost (Jasinski, 2000). Unfortunately, the problem of nuclear waste disposal often overshadowed the advantages of nuclear energy in most energy policy discussions.

Signatory countries to the Kyoto Protocol have also not been able to transcend the politics of nuclear energy use because of the opposition to nuclear use by institutions in member countries. However, some countries continue to push for the use of nuclear energy as a Clean Development Mechanism or for Joint Implementation purposes in GHG emissions reduction programs. "*Green*" countries, including Sweden, oppose making the Kyoto Protocol a *"pro- nuclear protocol"* (www.nea.fr/html/ndd/reports/2002), despite the scientific evidence that it is a low GHG energy source. According to the Full Energy Chain accounting, nuclear energy produces 2.5 - 5.7 gC_{eq}/KWh compared to between 105-366 gC_{eq}/KWh and 2.5-76 gC_{eq}/KWh for the carbon content of most fossil fuels and renewable energy, respectively (www.nea.fr/html/ndd/reports/2002).

Privatization of the energy market and pressure from consumers led to the steady reduction in the rate of the FFL. The levy's support for the generation of nuclear energy was also discontinued. The rate of the FFL was reduced from 10.6%, to 0.9% of a consumer's electricity charge between 1990 and 1998 (table 6-2). The rate decrease translated into approximately a £19 a year decrease in average domestic consumer's energy bills (Jasinski, 2000). Since the FFL

supports renewable energy, the decrease also affected the financial support for renewable energy.

The Climate Change Levy Agreement (CCLA) was introduced in 2000 as part of the UK Climate Change Program 2000.[27] The Climate Change Levy (CCL), a tax on the carbon content of energy used by businesses, replaced the FFL. The tax is currently a flat rate of 0.43p/kWh on electricity 0.15p/tCO_2 on coal and gas, and 0.07p/kWh Liquefied petroleum gas (Steen &Vrolijk, 2002). CCL's revenues are used to establish a carbon trust for low carbon energy technologies including energy efficiency and renewable energy.

The Gas Act of 1986 complemented the Electricity Acts' of 1983 and 1989. OFFER and OFGAS[28] were created as regulatory bodies for gas and electricity, respectively. These bodies were required to set Energy Efficiency Standards of Performance[29] (EESOPs) (Leonard, et al., 1998). OFFER required electricity suppliers to produce a specified terawatt hour figure of consumer energy savings through measures simulated by EESOP programs. Companies had the flexibility to also adapt and develop cost effective and innovative programs to meet efficiency standards. The targeted amount of energy cost savings per customer, according to EESOP-3[30] was £1.20 (Steen & Vrolijk, 2002).
Another objective of the EESOPs was to help low income "fuel poor[31]" families to afford renewable energy. Encouraging the poor to buy renewable energy will

[27] This program was based on Sir Collin Marshall's report. Economic instruments and business use of energy (London: His Majesty's Treasury, 1998). Lord Marshall chaired a government task force on how to strengthen GHG emissions reduction to achieve the country's goal. Before this, he was the President and Chairman of both the Confederation of British Industry and British Airways.
[28] Office for Electricity Regulation (OFFER), Office for Gas regulation (OFGAS)
[29] This scheme is designed to help households, especially low income families, to use less energy. Power companies are required by a government regulator to spend an equivalent of £1 per customer per year on more efficient use of electricity. A total investment of £100 million was anticipated to be spent in a quarter. Most energy companies are now designing programs that meet the government's scheme; as a result, most of the investment in EESOP has thus far gone into education on efficient lighting (Steen and Vrolijk, 2000).
[30]This refers to the third round of negotiation aimed at evaluating the effectiveness of renewable energy policies and projects.
[31] Fuel poverty remains an issue for families in UK. The government wants to ensure that increases in electricity prices as a policy to help the promotion of renewable energy are not excessive to price the poor out of the renewable energy market and further worsen their plight.

help increase the consumer demand base for renewable energy and help make it attractive to investors.

The Utilities Act of 2000 was scheduled to run from 2002 to 2005 and was designed to help low income groups, especially the "fuel poor." In a nutshell, the Utilities Act of 2000 was designed to increase the use of natural gas in electricity supply and efforts at efficiency promotion at the local and national levels (Runci, 2000). It established energy efficiency campaigns to promote energy best-practice and give domestic customers advice on how to improve heating insulation in housing. These schemes are projected to save up to 2.7 - 3.8MtC per year and reduce fuel costs for consumers, especially the "fuel poor" (Blair, 2000). The Utilities Act improved efficiency in electricity use, increased the use of renewable energy and encouraged fuel substitution (natural gas for coal), all of which are effective ways to help the UK meet its bubble and Kyoto Protocol targets (12.5% GHG emissions reduction) (Steen & Vrolijk, 2002).

UK also established emissions trading under directive 2003/87/EC of the European Parliament and Council. Emissions' trading was established to (1) reduce GHG emissions at a relatively lower cost to the economy (2) use emissions trading to fulfill EU bubble and Kyoto Protocol requirements (Comm. of E.C, 2003). The EU directive established GHG emissions trading EU-wide. According to the preamble of 2003/87/EC, the directive is designed to create the conditions for a more effective fulfillment of the reduction commitments of the EU through an efficient market for GHG emissions allowance with the lowest possible reduction in economic development and employment.

6.1-3 Achieving the Objectives at a Lower Cost Comparatively

The Electricity Acts of 1983 and 89 formalized market liberalization as the main objective of UK's energy policy. It was believed that liberalizing markets would allow market forces to allocate energy resources efficiently. The liberalized energy market in UK helped firms engage in emissions trading which had the potential to achieve emissions reduction at a comparatively low cost (Leonard, et al., 1998).

Liberalization also helped the "dash for gas" - the substitution of natural gas for coal (figure 7-1). The power sector was dominated by coal plants before liberalization, providing 66% of UK's electric generation fuel in 1988. Power production after liberalization increased by one-fifth compared to 1990 levels. CO_2 emissions also decreased by the same proportion over the same period, and coals share of generating fuel fell to 48% (Runci, 2000). Natural gas is considered friendlier to the environment than coal because it emits less CO_2 and particulate matter per unit of electricity generated.

Liberalization of UK's electricity markets led to falling electricity prices and increases in the quantity demanded of electricity. It also resulted in higher GHG emissions. Between 1990 and 1997, average annual domestic prices for electricity fell in real terms by 11% and 9%, respectively, while over the same years, real industrial energy prices fell by 46% for gas and 21% for electricity (Runci, 2000). To regulate the effects of liberalization on energy prices, the government of UK required energy producers to supply a proportion of the energy supply from renewable sources. To achieve this objective, Renewable Obligation Certificates (ROC) was awarded for electricity produced from renewable sources. Energy suppliers could achieve their renewable energy obligation in one of the following ways (1) buying renewable energy directly (2) buying ROC from a generator or supplier (3) paying a buy-out price set at 3p/kWh (adjusted for inflation) (Steen & Vrolijk, 2002).

This approach is designed to support renewable energy production by increasing certainty about renewable energy demand and helping lending institutions offer low cost loans for renewable energy projects (Ross, 2000).

The underlying objective of the UK energy policy was to allow market mechanisms to create the best practical solution to environmental problems, 'The Best Available Technique not Entailing Excessive Costs' (BATNEEC) (Smith, 2001). This approach to environmental regulation predates the middle of the

nineteenth century when The Alkali Inspectorate[32] was established. UK used BATNEEC in its GHG emissions reduction and renewable energy policies because UK's policy makers tend to believe in the use of market mechanisms and negotiations as cost effective tools for resolving environmental disputes.

6.1-4 Incentives for Innovation

The UK supports emissions trading and currently uses it in local GHG emissions control (Comm. of E.C, 2003). Theoretically, voluntary capping and trading emissions could achieve the cheapest emissions reductions.

The UK's desire to pursue emissions trading led to the establishment of an Emissions Trading Group (ETG), responsible for administering the country's emissions trading program. This group comprises members of an advisory committee on business and the environment, members of British industry, and government departments. The group secured Prime Ministerial endorsements of emissions trading and a commitment by the Chancellor of the Exchequer to provide after-tax incentives of £30 million for companies that agree to voluntary and flexible GHG emissions trading (Treasury's Spending Review, 2000). The GHG emissions reduction cap each energy supplier chose determined the price they could charge for electricity they supplied (Steen & Vrolijk, 2002). Companies could choose one or a combination of the following methods (1) buying quotas from other companies so that a company can exceed its GHG emissions (2) reducing emissions by emitting a specified quantity of GHG or selling their allocation (3) stimulating demand reductions by investing in clean energy methods to gain credit. The maiden auction was scheduled for February, 2002, and the Chancellor's incentive was scheduled to begin in 2002/03 trading year and continue for 5 years. Companies meeting their emissions reduction received an 80% discount from their Climate Change Levy (CCL) (Steen & Vrolijk, 2002).

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[32]This inspectorate has historical references. It is the World's oldest national pollution control body. Its first Chief Inspector Angus Smith believed that improvements would best be achieved by working with, instead of against, industry (Weale, 1997).

The desire of the UK government to become the first country to trade GHG emissions nation-wide was realized in April 2002. Among the large firms that took part were Shell, BP, Dupont, and British Airways (Vrolijk, 2002). About 31.5 million CO_2e emission permits were allocated and over 7.2 million permits were exchanged (sold) at a bid price. The transfers were either inter- or intra-company. In all, about 900 companies exchanged rights to emit in 2003. In 2002 and 2003 participating companies traded 4.64 million tons CO_2e and 5.2 million tons of CO_2e respectively (Steen & Vrolijk, 2002). This proactive position of UK in emissions trading makes it a leader in the EU. It also demonstrates the country's commitment to one of the cornerstones of EU climate change policy.

The use of taxes to reduce emissions has not been popular in the UK. Despite opposition, the FFL and the CCL have been used as part of a revenue generating mechanism to meet the additional costs incurred in GHG emissions reduction and the promotion of renewable energy. Revenues from the levy pool are reimbursed to renewable energy producers. Reimbursements are based on the cost incurred for complying with their renewable energy obligation, discussed earlier (Ross, 2000). There are about 248 renewable energy projects on-going. The projects include power generation from wind, hydro, and waste (Runci, 2000).

The UK Program 2000, introduced by the Marshall Report, also helped reconcile the role of taxes and other market mechanisms in an effective GHG emissions reduction program by recommending that both tools have important roles in meeting the country's bubble and Kyoto Protocol targets. The UK program established the foundation for the country's CCLA (Steen & Vrolijk, 2002). The CCLA recommended the following (1) the use of a tax (CCL) based on the carbon content of different fuels. (2) rates must be set to maximize the emissions savings resulting from the tax. (3) recycling the full tax revenues to business, considering the special needs of energy intensive industries (HM Treasury, 98).

The CCL policy became a "carrot and stick," because it punished high carbon energy users and encouraged technology and behavior that reduced the

carbon content of energy (Jasinski, 2000). This policy objective is in line with the overall EU strategy of creating low carbon economies across Europe. Investments from the levy's receipts will amount to €420 million by 2005 for offshore wind, biomass, and photovoltaic technologies (DEFRA, 2002).

Another flexible option available as an incentive to encourage energy intensive businesses wary of the CCL is negotiated agreements. Such agreements are designed to support energy companies that demonstrate their commitment to conserve energy. These companies' CCL is reduced by about 80% if they agree to sign a "negotiated agreement" to reduce their output-related carbon emissions over time. Forty UK companies have signed up for this program, and the agreement is expected to deliver energy savings up to 2.5MtC per annum by 2010 (Steen & Vrolijk, 2002).

On renewable energy projects financing, it was realized that existing financing methods did not favor the promotion of renewable energy. Changes made to address this imbalance include the extension of the period of evaluating and financing renewable projects (Ross, 2000). For example, some renewable energy projects that are feasible over a 25 year period appear infeasible in 15 years. In recognition of this fact, the second negotiation period for renewable energy NFFO-2 [33] agreed that financing periods for renewable energy should be longer than for non-renewable projects. The extension period will reduce fixed costs and change the price basis for funding renewable energy projects.

6.1-5 Effects of Policies on Different Sectors of the Economy

The FFL was designed as part of the electricity liberalization policy to protect the use of nuclear power. Arguably, the rationale for UK's promotion of its nuclear industry was energy security (Jasinski, 2000). Nuclear power, despite its environmental costs, appears to be a cheaper short-term way for UK to meet its Kyoto Treaty targets. Table 6-2 shows the contribution of nuclear energy to UK's fuel mix over time. Replacing nuclear in the fuel mix in the short-term can be

[33] This refers to the second round of negotiation aimed at evaluating the effectiveness of renewable energy policies and projects.

difficult because the contribution of nuclear to UK's energy mix grew from 10 to 30% from 1980-1997.

The presence of interest groups in a country often affects the negotiation dynamics and policy options for GHG emissions reduction. Among the main interest groups involved in renewable energy and emissions reduction in UK are the Confederation of British Industry (CBI), Advisory Committee on Business and the Environment (ACBE), British Petroleum (BP), and the coal lobby. Relationships among these groups are less adversarial compared to other countries. CBI and ACBE both demonstrate support for "*sound principles of environmental taxation and agree on the potential benefits of the introduction of emissions trading in UK and beyond*" (Runci & Dooley, 2000).

Interest groups also serve as catalysts in the formulation and review of efficient renewable energy policy targets. For example, Greenpeace's effort in 1991 set a national goal to increase renewable energy in Britain's energy use to 10% of total consumption by 2000. This goal was adapted by the Labor government in 1997, but was not achieved (Mitchell, 1996). Friends of the Earth described the projection of UK's renewable energy use estimate of 600MW declared net capacity by 2000 of the conservative government of Margaret Thatcher as *"pathetically low and not ambitious."* A later review increased this target to 1,500MW.

Most discussions about renewable energy and GHG emissions reduction have focused on the economic cost and political risks, but have failed to recognize the employment creation effects of such policies. Prime Minister Tony Blair acknowledged the dangers of inaction on the Kyoto protocol's proposals in a speech to inaugurate Britain's Climate Change 2000 Program, at the Royal Commission on Environmental Pollution. *"If there is one immediate issue that could bring global disaster, it is the changes in our atmosphere*" (Blair, 2000). The UK Climate Change 2000 program argues for a balanced approach that involves all sectors of the British economy. While this program will increase costs beyond the most cost effective measures for industry and consumers, it also provides employment benefits. The expected benefits include increased

employment opportunities through the development of new, environmental technologies (Steen & Vrolijk, 2002).

6.1-6 Global Positioning Purposes

The UK government's proactive market approach to GHG emissions reduction and renewable energy promotion can help improve the country's international competitiveness and position UK as a global leader in market based environmental solutions (UK Climate Change Program, 2000).

The UK electricity industry is forward-looking from the level of GHG emissions reduction it has achieved thus far. GHG emissions reduction between 1990 and 2000 amounts to 8% based on 1990 levels of the Kyoto Treaty targets. Emissions reduction continues to be central in all UK electricity generation companies (Steen & Vrolijk, 2002).

An EU-wide emission trading scheme for all its 25 member countries is slated for January 2005 (Runci & Dooley, 2000). UK is currently running a voluntary trading scheme and will be in a position to use its experience to help foster an EU-wide trading system. UK, with the world's largest financial market, will also be well positioned to take advantage of a possible lucrative emissions trading market, if its own first-of-its-kind nationwide emissions trading system is successful. According to a spokesperson for the British Prime Minister, Tony Blair *"this should be an attractive market for financial institutions to be involved in and with our experience, London is ideally placed to be a base"* (Peacock, 2003).

Also, British Petroleum (BP), a London based energy company, is arguably the world's most forward-looking energy company (Vrolijk, 2002). BP is gradually embracing the concept of low fossil fuels in its business practices worldwide. This idea began with a proposed name change from British Petroleum to Beyond Petroleum (BP). The Company had a voluntary internal emissions trading system among 10 of its 90 units worldwide for a start. This was expanded to cover all of its global operations in January, 2000, with an emissions reduction target of 10% below 1990 levels by 2010 (Vrolijk, 2002). Emissions targets

could be met through direct emissions reductions or through the purchase of permits. In the early stages of this experiment, small numbers of trades took place at a price of \$17-22/tCO_2 (BP, 2001). In 2000, around 2.7 MtCO_2 of emissions trades took place within BP branches world wide, at an average price of \$7.60/t. Divisional heads are personally responsible for meeting targets. Costs and revenues are identified separately, and do not affect the bottom line of the business units (Runci, 2000).

6.1-7 Meeting European Union Membership Requirements

In addition to accepting a 12.5% emissions reduction as part of a broad EU burden sharing effort, the government in its Climate Change 2000 document projects that the UK will achieve an additional GHG reduction of 60% below 2000 levels by 2050 (Blair, 2000). The country also believes that an energy policy based on emissions reduction will provide a range of cost-effective energy choices to all consumers in the UK, as well as across the spectrum of EU nations, in the form of better air quality and job creation (Blair, 2000). The government also believes that pursuing an EU-wide liberalization policy will improve overall security, flexibility, and efficiency of European energy systems and provide a range of energy choices and opportunities for British consumers and industry (Runci, 2000).

6.1-8 National Security Objectives

The overall security of the UK has been at the center of the evolution of its energy policy from the oil shock in the 1970s, the Gulf War of the 1990s, and the continued insecurity in the Middle East in the 2000s. The UK energy policy evolved from an outward policy of promoting energy research, development, and support systems abroad, to an inward policy of developing the local capacity to deliver renewable and low carbon based energy (Runci, 2000).

The government believes that diversity and liberalization are key components of energy security in the UK (Runci, 2000). Liberalization of the energy markets will provide the right incentives for new renewable energy

technology to thrive and help achieve the needed diversity, independence, and stability in energy sources and use (Ross, 2000).

Liberalization has proven to be a double edged sword. From Table 6-2, we see that the component of natural gas in the UK's energy mix grew from a minuscule 0.1% in 1980 to 27% in 1997. The security concerns created by increased use of gas include increased dependence on Russia and Algeria for between 55 and 90% of its supply. Neither of these countries have stable political and economic relations with the UK or the rest of the western world (Dooly, 2000). The increased use of natural gas, dubbed "the dash for gas," prompted the UK government to regulate the construction of new gas-fired power plants. This move, however sound security-wise, is believed to be in response to pressure from the coal mine workers (www.dti.gov.uk/public.html).

Other Climate Change related security concerns include the flooding of the Thames River. The Thames River barrier is used to protect London from estuary flooding. Estimates show that a single flooding today will cost £30 billion in damages, which is about 2% of the UK's current GDP (King, 2004). A single disaster of such magnitude is definitely a national security concern. UK, unlike Poland and Germany, designed its GHG emissions reduction and renewable energy policies to include the use of market mechanisms, taxes and regulations in a balanced approach to help achieve objectives at a relatively lower cost possible.

Chapter Seven
Analysis

Even though Germany, Poland, and the UK are all committed to GHG emissions reduction and the promotion of renewable energy under the Kyoto Protocol and EU bubble provisions, there are both similarities and differences in their approaches.

Each country continues to reform its environmental laws to conform to EU-wide deregulation and liberalization. The purpose of legal reforms is to create uniform trading standards necessary for the operation of an EU-wide energy market. It is believed that an EU energy market can help promote efficiency through competition, shut down inefficient energy companies, and promote the use of renewable energy technologies. Liberalization will also facilitate emissions trading and fuel substitution. To compensate for falling energy prices under liberalization and its negative effect on GHG emissions countries required energy producers to supply a proportion of their energy from renewable sources. This policy helped increase renewable energy use.

Taxes and subsidies were among the other policies used by the three countries. Taxes were generally used to internalize negative externalities and reduce GHG emissions. Germany used the Feed-In-Price (FIP); Poland also used the "polluter pays" principle to track down polluters. UK on the other hand used the Fossil Fuel Levy (FFL) and Climate Change Levy (CCL) to reduce carbon emissions. Most of the revenues from the tax levies were used as subsidies to help reduce the cost of producing renewable energy and stimulate its demand.

Emissions trading and regulation of energy markets were among the other policies used by Germany, Poland and the UK. There were however, some differences in countries' approaches to emissions trading and the use of GHG emissions regulations.

The broad differences in country policies include the use of market mechanisms, the level of taxes and regulations and also the use of subsidies in the coal industry. Germany's GHG emissions reduction and renewable energy

policies have been designed to achieve efficiency in energy use through the use of taxes and other regulations, with a limited use of market mechanisms (Janicke & Wiedner, 1997). The policy to phase out nuclear energy use by 2021, and the reluctance to fully commit to emissions trading unless it requires countries to achieve a fifty percent local emissions reduction, distinguishes Germany's approach to GHG emissions reduction. Subsidies in Germany were used to support the use of renewable energy and coal. Even though subsidies to the coal industry were reduced over time, the use of such subsidies was contrary to the objective of reducing GHG emissions. The coal subsidies reflect the power of the coal interest group and the role of such institutions in shaping countries' policy choices.

Poland's GHG emissions reduction policy focused on the coal industry because of the size of the sector and its contribution to CO_2 emissions. Like Germany, Poland uses fiscal policy tools (permits, taxes & fines) to regulate GHG emissions. Poland's policy choice stems from the fact that the development of market mechanisms is in their early stage (Anderson & Fiedor, 1997). Companies that emit the Kyoto basket of GHG emissions were required to obtain permits. The permit process was used to regulate and tax all GHG emissions exceeding approved limits. The country also continues to subsidize the use of coal but at a much reduced level. On emissions trading, Poland's parliament has approved its use, and hopes to benefit financially from an EU-wide emissions trading which begins in 2005 (Polish Parliament, 2002).

Unlike Germany and Poland, the UK uses a mixed policy approach (Steen & Vrolijk, 2002). The country relies mainly on market mechanisms but uses some fiscal policies. CCL and emissions trading are the main policy tools used to achieve GHG emissions reduction. Subsidies are used to promote renewable energy but not to support coal use. UK continues to use nuclear energy in electricity because it produces fewer emissions. The UK uses fewer regulations. Its policies are designed to ensure that cooperation between energy producers and regulators results in GHG emissions reduction at a relatively lower cost (Lowe & Ward, 1998).

Germany, Poland and the UK have each achieved significant GHG emissions reductions despite the differences in their approaches. Germany had achieved a 16% GHG emissions reduction from 1990 levels by 2000 (figure 7-2) (IPCC, 2001). About half of their emissions reduction was achieved from the "wall fall profits." (RWE, 2003).

Poland had achieved a 32.3% GHG emissions reduction from 1988 levels by 2001 (table 7-1) (Ministry of Environment, 2004). Ratification of the UNFCCC GHG emissions reduction plan for the country in 1988 and reforms undertaken in the coal industry: closing down inefficient coal plants, reduction in subsidies to the coal industry, and investments in the country's energy sector (figure 5-1) - have helped achieve the level of GHG emissions reduction. Poland's GHG emissions reduction was possible also because of reduced economic activity during the transition period and a transformation recession from 1990 to 1994. GDP growth rates in 1990 and 1991 were -11.6% and - 7.0% respectively, even though GDP growth was positive 7% in 1997, economic growth stalled again between 1998 and 2000 (Blazyca, et al., 2001). Unemployment in Poland was 15% and 20% in 2000 and 2003 respectively (www.eiu.com). From table 7-3, the highest levels of CO_2 emissions reduction 95.9 and 22.6 million tones of CO_{2eq} were recorded during 1988 and 1990 and 1998 and 2000 respectively. Poland was in a recession in both periods. The increase in CO_2 emissions in 2001 from table 7-3 represents the beginning of economic growth in Poland. The increase in CO_2 is arguably evidence that CO_2 emissions reductions achieved in Poland may erode if economic growth is prolonged.

The UK had achieved an 8% GHG emissions reduction from 1990 levels by 2000 (Grummer & Moreland, 2000). Liberalization of UK's energy markets led to the "dash for gas" (figure 7-1) (Steen & Vrolijk, 2002). About half of UK's GHG emissions reduction was achieved through the "dash for gas." UK's local emissions' trading is more market focused and has made the country a leader in the use of market mechanisms in GHG emissions reduction.

The differences in countries approaches to GHG emissions reduction and the promotion of renewable energy are explained in their legal reforms, emissions trading, flexible and fiscal policies and also in their environmental politics.

7.1-1 Legal Analysis

According to North (1990), the formal rules, informal constraints and the way in which they evolve help us understand differences in institutions. The GHG emissions reduction and renewable energy policies of the three countries could be explained by how the legal framework of the EU energy market influences each country's energy policy.

Energy law reforms in the three countries were similar, primarily because of each country's EU membership. The reforms were driven by Article 100a and 130r of the EU Single Energy Market (Heinelt et al., 2001). These laws require the liberalization of energy markets EU-wide, as a policy that will help achieve GHG emissions reduction and renewable energy promotion. The legal reforms will also create a standard framework for evaluating countries GHG emissions reduction programs towards meeting their EU bubble and Kyoto Protocol targets (Vrolijk, 2002). Germany's Energy Law reforms in 1998, Poland's New Energy Law of 1997 and the UK's Electricity Act of 1989 all focused on the liberalization of their energy markets and GHG emissions reduction to conform to their collective EU membership requirement (Heinelt, et al., 2001). The underlying influence of EU laws on member countries GHG emissions reduction policies is again evident in EU directive (2003/87/EU) on emissions trading. Each of the three countries is currently working towards the EU-wide emissions trading scheduled to begin in 2005.

7.1-2 Emissions Trading

The profitability of emissions trading depends on the differences in marginal abatement cost between individuals, businesses, and/or countries. For example, according to Poland's Parliament, the country's CO_2 emissions savings accrued from its reforms can be sold for an estimated \$10t CO_2 (Polish

Parliament, 2002). The price in Poland differs from the estimated cost of €5-16/tCO_2 in the UK (Vrolijk, 2002). When we consider current exchange rates, approximately \$1.25/€, Poland's CO_2 emissions cost approximately €8tCO_2. This difference in cost and fluctuations in exchange rates can make emissions trading possible and relatively cheaper between Poland and the UK. Negotiation can result in a mutually agreeable price that will benefit both countries economically and environmentally. The EU directive on emissions trading (2003/87/EC) estimates that separate domestic emissions trading schemes will be one-third more expensive than a harmonized EU-wide emissions trading scheme (Comm. of E.C, 2003). According to The Kyoto Protocol provisions, global emissions trading may officially begin in 2008 depending on the number of countries that ratify the Kyoto Protocol for implementation. EU-wide emissions trading, however, is scheduled to begin in 2005 (McGowan, 2000). The EU also believes that liberalized energy markets will create a uniform standard for pricing emissions, and help verify emissions allowance used for trading.

Although Germany is committed to EU GHG emissions reduction under the bubble and Kyoto Protocol requirements, the country's response to EU-wide emissions trading has been "cautious." Germany's cautious approach stems from fundamental differences with EU emissions trading (Weidner, 1991). Germany traditionally prefers a strong regulatory approach to environmental policy (Steen & Vrolijk, 2002). The market approach to emissions trading makes it a difficult policy choice for the country. It also explains why the country believes EU emissions trading projections are overly optimistic (Leonard, et al., 1998). German preference for strong environmental regulation is historical. It also reflects the influence of political institutions in environmental policy. The effects of acid rain and other environmental pollution on dying forests in Germany in the 1970s, and the Chernobyl nuclear power catastrophe, began attracting the attention of the broader general public beyond specialized circle of experts. These events culminated in the creation of a broad based eco-social movement and the birth of the Green Parties at the local and national levels. These groups demanded governmental regulations for environmental protection (Hey & Brendle, 1994).

This approach to environmental policy was consolidated towards the end of the social/liberal coalition government in the 1980s.The approach crystallized and became institutionalized after the election of the conservative/liberal coalition in 1982 (Weidner, 1991).

The growth of the Green party in Germany and its institutional distrust for market mechanisms has arguably contributed to the skepticism about emissions trading in the country (Park, 1997). Most of the GHG emissions reductions in Germany have been achieved through the use of other EU and Kyoto Protocol policies. The lack of consensus among German businesses on emissions trading helps explain the luke-warm acceptance of emissions trading in the country. It also shows how existing institutions have influenced Germany's environmental policy overall.

Poland's emissions trading policy, it is hoped, will result in a financial gain, reduced GHG emissions, and strengthened use of market mechanisms (Polish Parliament, 2002). The country has suffered environmental damage from its overdependence on coal for energy and subsequent GHG emissions. For example, total economic loss from environmental degradation in 1998 alone was estimated at $3.4 billion (www.countrystudies.us/poland/25/htm). A successful emission trading program could help reverse these losses if trading also results in a reduction of GHG emissions. Emissions trading can also make the country a leader in market driven solutions to environmental problems in Eastern Europe. These are compelling interests, and suggest reasons for Poland's decision to support an EU- wide GHG emissions trading program (Polish Parliament, 2002).

The UK's emissions trading program is an attempt to position the UK to enjoy any first mover advantages that accrue from an EU-wide GHG emissions trading. Britons also believe that creating successful local GHG emissions trading will position the country for financial advantage when the EU-wide emissions trading begin in 2005. According to Prime Minister Tony Blair, a local GHG emissions trading program helps financial markets in London gain experience in emissions trading finance. This experience will also help make financial institutions in London ideal for an EU-wide emissions trading (Johnson, 2003).

Institutionally, London is regarded as the financial center of the world because of its geographical position; securities markets in the East and West rely on London's trading activities to forecast their markets and global market activity. Approximately 40% of global market securities are traded in London daily (Grubb & Matsuo, 2001).

The UK's emissions trading program began in 2002, almost three years before an EU-wide trading. This proactive approach to GHG emissions reductions reflects the country's acceptance of and interest in market mechanisms, which are the basis for emissions trading. It also explains the institutional belief of the country in "the best practical option[34]" approach to GHG emissions reduction using negotiation to determine the efficient allocation of environmental costs and benefits (Lowe & Ward, 1998). Emissions trading arguably follow the same principle; it depends largely on the demand and supply of GHG emissions to set market prices. This approach is both flexible and relatively cost effective.

According to Lee Solsberey,[35] another underlying reason why the UK is making progress with emissions trading is; the country's emissions trading system is driven by tax based pressures. This program uses a "carrot and stick" approach of incentives and penalties (explained in chapter six above). This approach is also absent in Germany's and Poland's emissions trading policies. Despite the expected lower cost of emissions reduction under an EU-wide emissions trading scheme, countries continue to have differences over the specific application of this approach (Vrolijk, 2002). The differences include, how to create uniform and verifiable GHG emissions standards that will be accepted across countries and also discourage the use of "hot air[36]" for emissions trading credits (Vrolijk, 2002).

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[34] See footnote Alkali inspectorate, under The UK's legal analysis.

[35] Lee Solsbery is an environmental resource manager in the UK and a member of the World Business Council of Sustainable Development. According to him, emissions trading entail many quirks and complexities and as a result most countries and companies engaged in it are still learning how to make it work locally.

[36] This refers to the emissions reduction in Russia that have resulted in a depressed economy and also non-verifiable GHG emissions reduction allowances that countries declare and hope to use such allowances for an emissions trading program.

7.1-3 Flexible Mechanisms

Among the flexible mechanisms currently being used to reduce GHG emissions in the EU include the "wall fall profits" in Germany and "dash for gas" in the UK (Grubb & Matsuo, 2001) and arguably the Kyoto Protocol GHG emissions reductions credits Poland receives from UNFCCC reforms. Poland's reforms began in 1988 (Ministry of Environment, 2004).

These flexible policies are responsible for half the GHG emissions reduction in Germany and the UK from 1990 Kyoto Protocol levels by 2000 as shown in figure 7-2 (Grummer & Moreland, 2000), and all of Poland's reduction (table 7-1) (EEA, 2003).

Germany and the UK have both been at the forefront of the EU's GHG emissions reduction and the promotion of renewable energy. Each country has pursued a host of policy options, but, so far, the "wall fall profits", the "dash for gas", and reforms in Poland since 1988 have produced the largest immediate benefits in terms of reducing GHG emissions. As a result of the "wall fall profits" gross energy consumption fell from 550 billion kWh in 1991 to 545 billion kWh in 1998 (Pfaffenberger & Otte, 2000). This translated into GHG emissions savings for Germany under Article 4 of the Kyoto Protocol's joint implementation mechanisms. The UK, on the other hand, reduced GHG emissions by about 8%, from 168MtC in1990 to 155 MtC in 2000, as a result of the increased use of natural gas in electricity generation (Steen & Vrolijk, 2000). Poland also achieved a 30.3% GHG emissions reduction from 1988 levels by 2001 (table 7-1). Energy market reforms began under UNFCCC rules that targeted inefficiency and CO_2 emissions in the coal industry (EEA, 2003).

GHG emissions reduction, achieved by each of the countries using flexible mechanisms, is substantial. In figure 7-2, we see that some EU member countries have not significantly reduced their CO_2 emissions. As a result, overall GHG emission reductions in the Union, despite Germany and the UK's success, currently accounts for only 2% of the projected 8% bubble reduction by 2012. Despite changes in EU composition, an attempt by other EU member countries to implement emissions trading and other forms of flexible GHG emissions

reduction policies (joint implementation and clean development mechanisms), comparative to Poland's emissions reductions, will help the EU to limit GHG emissions growth to 1990 levels and advance the EU towards achieving its stated Kyoto Protocol target 8% reduction in GHG emissions by 2012.

Figure 7-1 also shows how fuel substitution impacted the UK's GHG emissions reduction policy. The UK's "dash for gas" policy helped the country reduce emissions by 35Mt CO_2 emissions between 1990 and 2000. This was achieved when natural gas usage in electricity generation increased from zero to about 140TWh within the same period. The use of coal fell from 210TWh to 100TWh within the same period (figure 7-1).

Arguably, natural gas will be more expensive than coal in immediate costs, but an environmental cost and benefit analysis will show that the true cost of natural gas will pale in comparison to coal. Fuel substitution policies are viable policy options for countries looking forward to reducing their CO_2 emissions as a step towards fulfilling their Kyoto Protocol obligation. Fuel substitution enables a flexible reduction of coal use for coal dependent countries like Germany and Poland. Of significant importance to the "dash for gas" program in the UK were: liberalization of energy markets, exploration of natural gas in the North Sea, the emergence of the CCGT technology[37] and also favorable political policies (Watson, 1998). The objectives to liberalize energy markets in the 1980 s by the conservative government were: introducing competition and reducing the political and economic clout of the national union of mine workers (Watson, 1998). Liberalization resulted in the proliferation of CCGT technology and the closure of coal mines and coal fired power stations. Currently, there are less than 20 coal pits in UK, but the country had as many as 191 coal pits in 1983 (EU Statistics, 2004). The availability of the CCGT technology and its flexibility (used in power generation and aerospace (jet engines)), and also the proximity of natural gas

[37] Combined Cycle Gas Turbines(CCGT) technology was introduced to the UK electricity market in the late 1980 s.This technology uses gas turbines in an arrangement known as 'combined cycle' to generate electricity. CCGT has become attractive because of its low capital cost, high thermal efficiency and relatively low environmental impact.

exploration, helped UK to promote the 'dash for gas' program as a way to reduce GHG emissions.

Looked at differently, the 100TWh reduction in GHG emissions in the UK (figure 7-1), comes down to an average of 10TWh annually. This example indicates that fuel substitution could help lower global GHG emissions significantly if natural gas reserves are economically viable and the cost of switching to natural gas is comparatively lower.

In addition, the economic viability of the "dash for gas" could help initiate a gradual reduction of the carbon content of fuels. Available and cheaper natural gas will also help reduce the cost of implementing the Kyoto Protocol provisions. The "dash for gas" also helps provide a compelling case against the argument that the Kyoto Protocol is inflexible, and that implementing its provisions will result in economic stagnation. Arguably, global trade in natural gas may be cheaper than coal when we consider the effects of coal subsidies.

Germany and Poland have begun similar fuel substitution programs (natural gas for coal). For optimum results, governments of both countries must remove coal subsidies and allow market mechanisms to determine the fuel mix for electricity, as in the UK. Removing coal subsidies can be difficult in Germany and Poland because of institutional factors – the relative importance of coal to both economies and the economic strength of coal unions (Jasinski & Pfaffenberger, 2000). The conservative government's traditional belief in market principles did not make it a friend of labor unions and UK did not subsidize coal production or use. These factors made the 'dash for gas' program relatively less difficult to implement. UK's relative success with the "dash for gas" program compared to Poland's and Germany's use of subsidies and relationship with unions, explains a difference in approach to GHG emissions reduction. It also shows how institutions like the coal mine unions influence countries policy choices.

Germany's "wall fall profits," the "dash for gas" in the UK and Poland's emissions reductions are compelling arguments to show that the Kyoto Protocol's

objectives can be implemented in a relatively cost efficient way, if countries "*think outside the box*" and make flexible adjustments to their energy policies.

7.1-4 Fiscal Policy Analysis

Governments traditionally use fiscal policy including taxes, subsidies and directed spending to direct societies towards specific objectives. The three countries under study have each used taxes, subsidies, and other forms of government regulation to reduce GHG emissions and promote renewable energy.

Germany introduced the ecological friendly tax reform on fossil fuels in 1999 (Shiffer, 1999), as part of its broader environmental reforms. This tax was called a double dividend tax because it redistributes revenues from GHG emitters to the research and production of renewable energy, which may result in future environmental benefits. Tax policies that create a double dividend effect attempt to correct a flaw in taxation - deadweight loss.[38] The double dividend may neutralize the dead weight effect. A tax may also be efficient when the marginal tax is commensurate with the negative externality created. By designing the ecologically friendly tax to have a double dividend effect, Germany sought to optimize the benefits of this tax policy.

Equally effective economically is the green electricity pricing introduced in Germany. This policy ensures that electricity from renewable energy is sold at a 30% premium to consumers who demand such energy for environmental reasons. This approach to promoting renewable energy use involves price discrimination.[39] It can be argued that the high level of environmental consciousness in Germany, evident in the country's constitutional provision, helps promote such green electricity pricing.

Renewable energy, unlike traditional fossil fuels, emit relatively low GHG, but the high cost of production which results in higher prices and lower use. Germany used the Feed-In-Price as subsidies to promote renewable energy.

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[38] This is an economic loss that often results from imposing a tax. The incidence of a tax on energy results in higher prices and lower demand.

[39] This concept explains the process of selling an item at different prices to different groups of people when production costs are identical. This is possible because; the goods are produced at different costs and also different groups value the same item differently.

This subsidy reduces renewable energy companies' cost and price, thereby making renewable energy competitive and affordable. Economically, the cost of a subsidy, and the source of financing such subsidies are important in evaluating its effect. The Feed-In-Price increased the price of electricity from fossil fuels by approximately 0.05 to 0.1e/kWh; the total cost of this subsidy was projected to be approximately €1.23 billion (Steen & Vrolijk, 2002). It is expected that Feed-In-Price will increase renewable energy use by approximately 10% in addition to reducing carbon dioxide emissions by 20-30Mt by 2010 (Steen &Vrolijk, 2002). The increased cost of electricity from fossil fuels 0.1e/kWh also will lead to a reduction in the quantity demanded of such electricity and subsequent GHG emissions.

Figure 4-1 shows the impact of taxes on electricity prices in Germany. Higher prices results in low quantity demanded of electricity and a reduction in electricity related GHG emissions. The use of taxes and regulations to control GHG emissions in Germany have been possible because of historical reasons (Hey & Brendle, 1994) and the presence of strong political and environmental institutions like the Green Party which support such policies (Weidner, 1991).
The constitutional support for environmental protection and the political clout of these environmental institutions arguably increases the reluctance to accept emissions trading as a market mechanism for GHG emissions reduction.

Poland, like Germany, also used taxes and subsidies to reduce GHG emissions and promote renewable energy. But unlike Germany, the underlying reasons shaping the Polish approach include an underdeveloped market infrastructure for effective use of market mechanisms, the continued existence of the vestiges of central planning, and the need to internalize negative externalities. The use of the "polluter pays" principle emerged after the 1991 and 2001 amendment of the State Environmental Protection Inspectorate directive "eco development" (Ministry of Environment, 2004) calling for the elimination of the socialist mindset of "social interest" in the use of Poland's resources. The changes called for the fixing of responsibility for the negative externalities of resource use at the source.

Poland also reduced subsidies to the coal industry by approximately 35%, resulting in a 13% increase in coal prices (Sobolewski & Zylick, 2000). Subsidies generally distorts market price. Coal subsidies make coal cheap, increase its use and create CO_2 emissions. It also makes promoting renewable energy and GHG emissions reduction difficult.

The use of environmental regulations in Poland also led to the closing down of 136 inefficient power plants. The use of higher taxes, lower subsidies, and regulations constitute aggressive fiscal policies. Arguably, the need for GHG emissions reduction and the inherent institutional weakness - underdeveloped market economy increased the use of fiscal policies and made the use of other market based emissions reduction policies difficult in the short term.

The UK, like Germany, and Poland, used taxes and subsidies as policy tools to reduce GHG emissions and promote renewable energy. Unlike the other two, however, the UK strived for a balanced approach. Fiscal policies were designed to complement emissions trading as effective ways to reduce GHG emissions. The underlying reasons for these approaches are both institutional and political. Under BATNEEC UK created procedures involving negotiation and compromise for resolving environmental issues which results in low cost for businesses. The belief that higher environmental regulations affect market operations was fundamental to UK's approach to GHG emissions reductions. The political dominance of the conservative governments in the 1980s and early 1990s helped entrench market principles in UK. Most of the fiscal policies introduced were designed to complement market mechanisms in a balanced approach.

The use of revenues from the FFL to promote both nuclear and renewable energy is evidence of the policy balance. Using nuclear energy for electricity is one of the cheapest and cost effective ways to reduce GHG emissions and promote renewable energy in the short term (www.nea.fr/html/ndd/reports/2002).

After phasing out the FFL, UK used the Climate Change Levy (CCL) to specifically target carbon emissions. Revenues from the CCL were used to promote renewable energy and low carbon technologies. The 80% waiver of CCL for energy companies that participated and met their emissions trading targets

underscores UK's institutional belief in market mechanisms and its important role in achieving effective GHG emissions reduction. According to (Lowe & Ward, 1998), UK historically prefers a more gradual and pragmatic market centered approach to GHG emissions reduction that does not entail excessive costs.

7.1-5 Environmental Politics

Climate change politics discussions center on controlling GHG emissions believed to cause global warming versus the cost and accuracy of the science of climate change. Generally, a radical reordering of political and social preferences and the exploration of the interface between these preferences may be better than favoring any one of these preferences in contemporary debates. The influence of special interest groups on both sides of the debate often shapes the discussions as well as the policies. Since each of the countries in this study is democratic, understanding their environmental politics strengthens our understanding of the politics of the Kyoto Protocol as it relates to GHG emissions reduction and the promotion of renewable energy in the different countries.

A look at Poland under central planning and its transition to embrace capitalism and democracy provides evidence of the influence of politics. According to Hicks (1996), the fundamental lack of the rule of law under Soviet-occupied Poland made environmental protection difficult, especially because the oligarchy did not consider environmental protection a worthy goal. This attitude has shifted with recent liberalization policies and the introduction of environmental taxes, fines, and emissions trading. Poland's EU membership requires these environmental reforms to bring policies in line with EU standards. The inherent difficulty is that these reforms increase energy costs and are often passed along to consumers. As a result, public support for environmental protection typically wanes when the public recognizes that reforms entail economic costs (www.countrystudies.us/poland/25/htm).

The fact that Poland successfully reformed its environmental policies and joined the EU in May 2004 reflects the role of the country's leadership in navigating this socio-political maze. It also can be argued that the expectations of

benefits from EU membership, and the promise of economic and financial opportunities from relationships with the rest of Europe helped alleviate the short term economic and political costs of environmental reforms in Poland.

On the other hand, the extreme destruction of their forests in Germany and the Chernobyl nuclear accident in Russia helped develop eco-activism in the country. The sympathetic social/liberal governments in the 1980s also helped institutionalize the use of taxes and regulations for environmental protection (Hey & Brendle, 1994). The growing politicization of environmentalism also helped give birth to the Green Party in Germany (Weidner, 1991). In 1983, the Green Party held 27 seats in the Bundestag and the Party won 15% of all votes cast in the 1994 elections. This proportion was large enough to successfully influence legislation through strategic coalition building. To make environmental protection a national priority, the Bundestag amended the constitution in 1994, making environmental protection equally important to economic growth (Park, 1997).

The national policy to phase out nuclear energy by 2021 also appears politically motivated. Though nuclear energy produces the lowest CO_2 emissions and is relatively cheaper (www.germany-info.org/relaunch/politics.html), the platform of the Green Party promotes the elimination of nuclear energy as a fuel source. The increasing problems of nuclear waste disposal in an era of global terrorism, promotes fear and help make the argument for the elimination of nuclear energy credible on environmental and security grounds.

Continued coal subsidies in Germany create a potential hurdle to achieving both the EU bubble and Kyoto Protocol targets. Resistance from the unionized coal workers makes complete removal of subsidies politically difficult. Negotiations between the government and the coal workers union are expected to reduce subsidies by about half by 2005; from €6 billion to €2.8 billion (Steen & Vrolijk, 2002). This decision is both environmentally and economically flawed, because continuing to subsidize coal with € 2.8 billion creates inefficiency and works against reducing GHG emissions. Also, the subsidy amount could have been more efficiently utilized by spending the subsidy on renewable energy or research into clean coal technologies. This decision can only be understood within

the socio-political context. Removing total coal subsidies will increase energy prices and the cost of steel because 20% of German steel companies' energy comes from coal (Schleich et al., 2002).

Despite the costs of increased taxes on electricity, (figure 4-1), Germans have shown to some extent their tolerance for high energy taxes. This will help the country towards fulfilling its EU bubble and Kyoto Protocol targets because higher energy taxes can be one of the effective ways to reduce GHG emissions rapidly, even though it comes with political and economic costs and make most governments cautious about using those policies.

Unlike in Germany, the UK's Green Party has not significantly impacted the county's environmental policy. The party presented 643 candidates at the local municipal elections in 1989, but won only 8.6% of the votes. Its impact on the UK politics has diminished since 1989 (Taylor, 2004), leaving the Conservative and Labor Parties as the main political parties with ideological differences on environmental policy in the UK *"It is time to re-awaken the environmental challenge as part of the core of British and international politics.*[40]" This statement by Prime Minister Tony Blair, of the Labor Party, alludes to passive environmental policies of the Conservative Party under both Prime Ministers' Margaret Thatcher and John Major. For example, Margaret Thatcher signed the Environmental Protection Act (EPA) into law in 1990, only after intense pressure from the Royal Commission on Environmental Pollution and other environmental groups (Weale, 1997).

The differences in environmental policy between the two dominant political parties in the UK have significantly impacted environmental politics. Before Margaret Thatcher became Prime Minister in 1979, electricity was produced and supplied by the UK's 12 regional boards. But between 1979 and 1997, when the Conservative Party left office, electricity had been completely privatized, ninety percent of all electricity was bought and sold through a

[40]This was in reference to the Royal Commission on Environmental Pollution report at a conference in 2000 (Vrolijk, 2002).

competitive exchange, and the fuel mix had completely changed (Steen & Vrolijk, 2002).

Table 6-2 shows that coal, natural gas, and nuclear dominated electricity production within this period. Due to privatization, natural gas and nuclear became dominant energy sources in the UK. For example, the use of nuclear increased by 20%, from 10 % to 30%, from 1979 to 1997. The argument made in support of this market approach is efficiency and lower prices, even though this may not always hold true economically. Environmentally, lower energy prices for power produced from fossil fuels, increase the quantity demanded for such power and hence GHG emissions.

Market liberalization clearly supported the introduction of emissions trading, although it may not always have resulted in the most efficient resource allocation. According to Stiglitz 2003, in a world of imperfect information, the argument that market mechanisms always result in efficient allocation of resources without regard to the problems, creates "*market fundamentalism.*" The UK, under Margaret Thatcher, became known in Europe as "*the dirty man of Europe*" despite the Prime Minister's belief that liberalization and energy market reforms would result in the control of GHG emissions. She also resisted the establishment of the Environmental Protection Agency (EPA) and uniform environmental standards across Europe. Margaret Thatcher's resistance to establishing the EPA reflects the institutional belief of the Conservative Party that regulations are expensive for business, even though this belief may not always be true (Rose, 1990).

The Marshal Report in 1998 became the basis of the UK's climate change program (Steen & Vrolijk, 2002). This document concluded that *"There is a role for a tax if businesses of all sizes and from all sectors are to contribute to improved energy efficiency and help meet the UK's emissions reduction target."* The Labor Party, on the other hand, often disagreed with the Conservative approach to solving environmental problems. They argued that over-reliance on market mechanisms can result in higher average energy prices that will be beyond the means of average and low income consumers, thus creating the "fuel poor."

One of the first pieces of legislation introduced by the Blair administration was to reduce the Value Added Tax (VAT) on electricity to 5% - the lowest possible in the EU (Schleich et al., 2002). The British government under Blair was initially preoccupied with reversing the effects of the Conservative Party's pro-market policies on both the environment and low income groups (Steen & Vrolijk, 2002). To the extent that the Conservative government's approach to energy market liberalization created problems, Stiglitz's argument was strengthened. It also demonstrates the fact that a more balanced approach to GHG emissions reduction and renewable energy promotion is needed. Skepticism from within the government (including the Deputy Prime Minister John Prescott) about the effectiveness of Labor's polices to reduce GHG emissions and achieve the Kyoto Protocol targets, led to the commissioning of the Marshal report. This report emphasized a mixed policy approach using both market mechanisms and regulations through negotiation. Taxes would be based on the carbon content of energy with revenues fully recycled to support less carbon energy as well as the use of emissions trading.

The Labor Party introduced a policy of green taxes in the UK using the Clean Coal Levy, the Fossil Fuel Levy Act, and premium pricing of electricity. Other policies introduced to complement green taxes include emissions trading and fuel substitution. All these policies contributed to the renewed commitment of the British government under the Labor Party to introduce new policies that complement the traditional "best practical option." According to an environmental group, Friends of the Earth, the government *"embarked on an unprecedented and substantive policy mix through greening of the tax and market mechanisms"* (Smith, 2001). These measures were aimed at bringing some urgency into the climate change argument, and also accelerate the commitment of the UK towards achieving the objectives of the Kyoto Protocol.

Despite the philosophical differences in policy between the Conservatives and Labor, the results achieved (figures 7-1 & 7-2) show that a mixed policy approach, combining fiscal policy and market mechanisms, can be very important

in achieving GHG emissions reduction goals. Political cooperation to achieve environmental policy results is equally important.

Chapter Eight

8.1-1 Conclusions

This thesis looks at the GHG emissions reduction and renewable energy policies of Germany, Poland, and UK as well as the underlying reasons for the differences in their choices of policies. From the country reports and analysis of each country's policies, it can be concluded that the countries pursue similar policies. There are, however, some differences in their approaches. The similarities and differences in their policies reflect the underlying presence of institutions like the EU and other institutional beliefs and practices that influence specific country policies. This conclusion is corroborated by North's (1990) perspective about institutions. According to North, the evolution of formal rules and informal constraints of institutions reflects the differences in countries policies.

Each country is currently using a combination of taxes, subsidies, market liberalization, emissions trading, energy market regulation, and deregulation to control GHG emissions and promote renewable energy. The similarities in policies are due to their common membership in the EU and the requirement to follow the EU's formal rules. The rules include Articles 100a and 130r of the Single European Act and directive (2003/87/EC). These rules promote the integration of environmental and energy policies, and emissions trading within a single EU energy market. These rules provide a framework for establishing uniform standards in member countries' energy markets, promote competition, and verify GHG emissions used for the Kyoto Protocol and EU bubble targets.

Differences in approaches are also identified in various countries' policies. The differences stem from historical and institutional factors, as well as beliefs that have become institutionalized over time. For example, the UK's domestic emissions trading was up and running by 2002, in anticipation of EU-wide trading in 2005. The UK's emissions trading program is an attempt to position the country's financial institutions for business opportunities during EU-wide trading. Germany and Poland are yet to begin domestic or international programs. Both

Germany and Poland have approved emissions trading officially (directive 2003/87/EC), but Germany's policies reflect skepticism about what it sees as overly optimistic market projections of GHG emissions reduction under emissions trading. The underlying reasons for German skepticism stem from the destruction of forests, the rise of an army of eco- activists wanting immediate action, and the birth of political institutions like the Green Party (Hey & Brendle, 1994). Green Parties traditionally distrust market mechanisms in environmental protection (Park, 1997). The importance of political coalitions to governance in Germany and the grass roots influence of the Green movement in that country arguably contributed to the use of relatively less market-based policies like taxes and regulations for the country's GHG emissions reduction and renewable energy.

The underlying reason for Poland's acceptance of emissions trading is financial expectations (Polish Parliament, 2002). From a broader perspective, Poland's GHG emissions reduction and renewable energy policies have been driven by the institutional collapse of central planning and the rise of democracy and democratic institutions in the 1990s (Sobolewski & Zylicz, 2000). Poland's GHG emissions reduction (32.3%) has been achieved mainly through taxes, fines, permits, the closing down inefficient power plants and also a transformation recession which resulted in a significant slow down of economic activity and growth (Blazyca, 2001). The use of these policies reflects the prolonged period of central planning, which made it difficult to use effective market mechanisms. Democratic elections in 1989 and 1990 led to the creation of democratic and environmental institutions that initiated reforms to reduce the country's GHG emissions from coal. For example, an open letter from environmental groups to the country's President in June 2002, calling for immediate ratification of the Kyoto Protocol, helped to achieve ratification a month later, in July, 2002 (Polish Ecological Club, 2002).

The UK, on the other hand, used a combination of emissions trading, green taxes, and moderate regulation. The underlying reasons for the UK's approach are efficiency and cost effectiveness. Even though Germany and Poland also promote cost efficiency in their programs, the UK's policies are more suited

to achieve this objective. The BATNEEC rule (achieving environmental protection with the best available technique and at the lowest cost possible) designed by the world's oldest pollution control institution continues to be applied in current GHG emissions reduction programs in the UK. This institutional belief transcended UK politics. The continued importance of nuclear power, green taxes, and emissions trading policies towards UK's GHG emissions reduction in the Labor government of Tony Blair demonstrates this institutional structure.

The results of each country's GHG emissions reduction policies reflect national idiosyncrasies and the role of institutional rules and beliefs. Figures 7-1, 7-2 and table 7-1 show the "wall fall profits" in Germany, "dash for gas" in UK, and 32.3% GHG emissions reduction in Poland, respectively. Germany achieved approximately half of its 16% emissions reduction (figure 7-2) from Clean Development Mechanisms investments in the former East Germany's energy systems after reunification in 1991. The UK also achieved approximately half of its 8% GHG emissions reduction (figure 7-1) by substituting natural gas for coal. The impact of the change in the UK's fuel mix is seen from figure 7-1. Poland's GHG emissions reductions have been achieved through taxes, closing down of inefficient coal plants, and the removal of subsidies.

Arguably, the various results and approaches used by the three countries lead to the conclusion that, the UKs policies have been the most market friendly. It also shows that the approach to GHG emissions reduction policies in Germany has been derived from the country's constitution and guided by the precautionary principle,[41] a concept particularly appealing to environmental groups. Poland's approach reflects a combination of German and the UK policies, but the transition is definitely heading towards embracing most of UK's market approach. From Table 7.3 it becomes evident that economic growth in Poland may result in the erosion of some of the CO_2 emissions reduction gains in the country.

In a nutshell, "the wall fall profits," the "the dash for gas," and Poland's emissions reduction results all strengthen the argument that the objectives of the

[41] This approach places emphasis on prevention and the proactive use of taxes and other regulations to reduce GHG emissions and promote renewable energy (www.germany-info.org/relaunch/politics/domestic/umwelt.html).

Kyoto Protocol are attainable when countries are creative and committed, even though it will require some sacrifice. The estimates according to the Inter-governmental Panel on Climate Change (IPCC), show that the Kyoto Protocol will cost most annex B countries between 0.1% to 1.1% and 0.2% to 2% of GDP with or without emissions trading, respectively, by 2050 (IPCC, 2003). The impact of this cost on countries will vary based on size, wealth, and energy intensity. Arguably, the cost should be seen as an investment in the planet's future, if it ends up stabilizing or slowing the growth of global warming.

As we witness Russia's long awaited ratification of the Kyoto Protocol and the full implementation of the Protocol's objectives, we must hope that the economic as well as the political benefits of implementing climate change policies will become more compelling.

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Table 4-1 Tax Rates Resulting from the Ecological Tax Reform in Germany (eurocents)

Fuels	Before April 1999	From April 1999	2000	2001	2002	2003
Light heating Oil[a]	4.1	6.1	6.1	6.1	6.1	6.1
Light heating Oil for industry[a]	4.1	4.5	4.5	4.5	4.5	4.5
Light heating oil for CHP[a,c]	4.1	-	-	-	-	-
Natural gas[b]	0.18	0.35	0.35	0.35	0.35	0.35
Natural gas for industry[b]	0.18	0.22	0.22	0.22	0.22	0.22
Natural gas for power generation[b]	0.18	0.18	0.18	0.18	0.18	0.18
Natural gas for CHP[b,c]	0.18	-	-	-	-	-
Electricity[b]	-	1	1.3	1.5	1.8	2
Electricity for public transport[b]	-	0.5	0.64	0.77	0.89	1
Electricity for industry[b]	-	0.21	0.26	0.31	0.36	0.41

[a] e/l

[b] e/kWh

[c] Only for CHP with an efficiency exceeding 70%

Petrol and diesel taxes rose by 3.1e/litre per year from April 1999 till 2003. This is in addition to initial increases of 55e/litre, 50e/litre, and 32e/litre on leaded, unleaded, and diesel fuels, respectively. The tax on natural gas also increased from 0.96e/kWh to 1.24e in 2003.

Source: Schiffer, Hans-Wilhelm, 1999

Table 4-2 Primary Energy Consumption in Germany 1997

Source of energy	PJ	Share (%)
Crude Oil	5727	39.5
Natural Gas	2984	20.6
Hard coal	2043	14.1
Lignite	1591	11
Nuclear energy	1858	12.8
Hydro and Wind Power	73	0.5
Foreign Trade Balance Electricity	-9	0
Other	223	1.5
Total	14,490	100

Source: Schiffer 1997

Table 4-3 Structure of Final Energy Consumption in Germany in 2020

Energy Source	Share (%)	Sector	Share (%)
Hard Coal	2.7	Industry	28.9
Lignite	0.8	Trade, Services, Military	17.7
Crude Oil Products	45.1	Households	23.2
Gases	25.9	Transport Sector	30.2
Electricity	20.8		
Distance Heating	4.1		
Others	0.6		

Source: Schiffer 1997

Table 5-1 Source of Electricity in Poland in 2001

Fuel Source	Unit(GWh)	% of Total
Coal	136879	93.9
Oil	2380	1.6
Biomass	444	0.3
Gas	1357	0.9
Waste	323	0.2
Hydro(H2O)	4219	2.9
Others	14	0.0
Total	145616	100.0

Source: IEA Energy Statistics, 2001

Table 5-2 Charges for Emissions of Atmospheric Pollutants in Poland in 1995

Atmospheric Pollutant	$US/ton
Acrylonitryl (aerosol), Asbestos, Benzene, Benzo-a-pyrene, Chlorinated Vinyl (gaseous)	$53,739.00
Arsenic, Chromium, Nickel (fee rates apply to metal content)	$53,739.00
Bizmuth, Cerium, Tin, Zinc, Cadmium, Cobalt, Manganese, Mercury Molybdenum, Lead (fee rates apply to metal content)	$26,869.00
Chlorofluorocarbon compounds, Carbon Tetrachloride, Dioxin, Halons, Polychlorinated Biphenyls, 1, 1, 1 tri-Chloroethane	$26,869.00
Heterocyclic compounds	$1,817.39
Nitric, nitrous, and related compounds	$700.00
Amines, Cyclic and Aromatic Alcohols, Organic and Elemental Sulfur	$360.87
Organic acids and related compounds	$291.30
Carbon Bisulfide	$252.17
Particulates (cement, silicate, fertilizer, solvent, carbon-graphite, carbon black), Ketones and Inorganic Acids, Aromatic and Cyclic Aldehydes Ether, Aliphatic and related Alcohols, Isocyclic compounds, Aromatic and cyclic hydrocarbons, Non-metallic elements, Non-metallic salts, Non-metallic oxides	$213.04
Aliphatic Aldehydes and related compounds	$143.48
Sulfur Dioxide, Nitrogen Oxides	$82.61
Ammonia, HCFCs, other Halons, Particulates (polymers and lignite), Oils	$73.91
Particulates from fuel combustion, all other particulates	$43.48
Carbon Monoxide, Hydrocarbons	$21.74
Carbon Dioxide, Methane (fee per ton)	$0.04
Charges for Evaporative Emissions	
Filling fuel storage tanks with fixed roof	$0.83
Filling fuel storage tanks with floating roof	$0.05
Filling underground and above ground storage tanks	$0.46
Filling train fuel tanks	$0.46
Filling car/truck tanks	$0.35
Filling automobile tanks	$0.51

Source: (Anderson and Fiedor, 1997)

Table 5-3 Environmental Fines and Charges (millions of $)

Environmental Fines and Charges (millions of $)					
	1990	1991	1992	1993	1994
Imposed charges and fines	31.1	523.1	649.6	660.6	585.9
Amounts actually collected	31.1	385.7	446.8	428.5	431.6
Collection efficiency rate (%)	96	73.7	68.8	64.9	74

Source: Kruszewski, 1994

Table 6-1 Percentage of Fuels Used for the Production of Electricity in UK- 1980 – 1997

Fuels	1980	1990	1997
Coal	73.4	65.0	38.0
Oil	11.1	11.0	2.0
Gas	0.1	1.0	27.0
Nuclear	10.0	21.0	30.0
Hydro	0.1	1.0	1.0
Other fuels	0.0	1.0	2.0

Source: DTI, UK Energy in Brief, 1998

Table 6-2 The Financial History of Fossil Fuel Levy, 1990 – 1998

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Rate (%) of electricity price	10.6	11	11	10	10	10	3.7	2.2	0.9
Payments to nuclear generators (million £)	1175	1311	1322	1166	1106	1109	1010		
Payments to renewable generators (million £)	0	13	26	68	99	96	95		

Note: Payments to nuclear and renewable energy generators for 1997 and 1998 could not be obtained. The levy was phased out in 1998.

Source: Annual Reports, Nuclear Electric, 1990-1998

Table 7.1 Kyoto Protocol Emissions Targets Compared with Projections to 2010 for Accession Countries in Central Eastern Europe

	Base year	Emissions target for 2008-2012	Change of emissions in 2001 compared with base year	Projected emissions change in 2010 based on existing domestic policies and measures	Gap between target and projected emissions in 2010 based on existing domestic policies and measures 1)	Gap between target and projected emissions in 2010 based on both existing and additional domestic policies and
		(% of base year emissions)	(% of base year	(in % of base year	(in % of base year	(in % of base year
Bulgaria	1988	-8	-50.7	-14.9	-6.9	-12.1
Czech Republic	1990	-8	-23	-31.4	-23.4	-26.7
Estonia	1990	-8	-55.4	-56.6	-48.6	-52
Hungary	ave. 1985-87	-6	-17.8	-6	0	no data provided
Latvia	1990	-8	-60.8	-58.2	-50.2	no data provided
Lithuania	1990	-8	-60.7		no data provided	no data provided
Poland	1988	-6	-32.3	-14.6	-8.6	-13.3
Romania	1989	-8	-44.0		no data provided	no data provided
Slovakia	1990	-8	-30.6	-26.6	-18.6	-25.5
Slovenia	1986	-8	1.4	9.6	17.6	6.5

Source: European Environment Agency, 2003

Table 7-2 GHG Emissions in Poland from 1988-2001 (million tones of CO_2 eq/year)

Specification of GHG emissions(CO_{2eq})	1988	1990	1996	1998	2000	2001	2001/1988
CO_2	476.6	380.7	372.5	337.4	314.8	317.8	66.7%
CH_4	66.0	58.8	47.3	49.0	45.9	38.8	58.8%
N_2O	21.8	19.4	16.7	16.0	23.9	23.9	109.6%
Fluorinated gases (HFCs, PFCs, SF_6)	0.8[1)]	----	0.8	1.0	1.6	2.2	275.0%
Total GHG emissions (gross)	565.2	458.9	437.3	403.4	386.2	382.7	67.7%
CO_2 emissions (net)[2)]	441.9	336.0	329.9	294.8	271.7	264.2	59.8%

1) Estimates for 1995

2) Considering CO_2 removals by sinks in agriculture and forestry

Source: GHG inventory report for 2001, IOS, Warsaw,

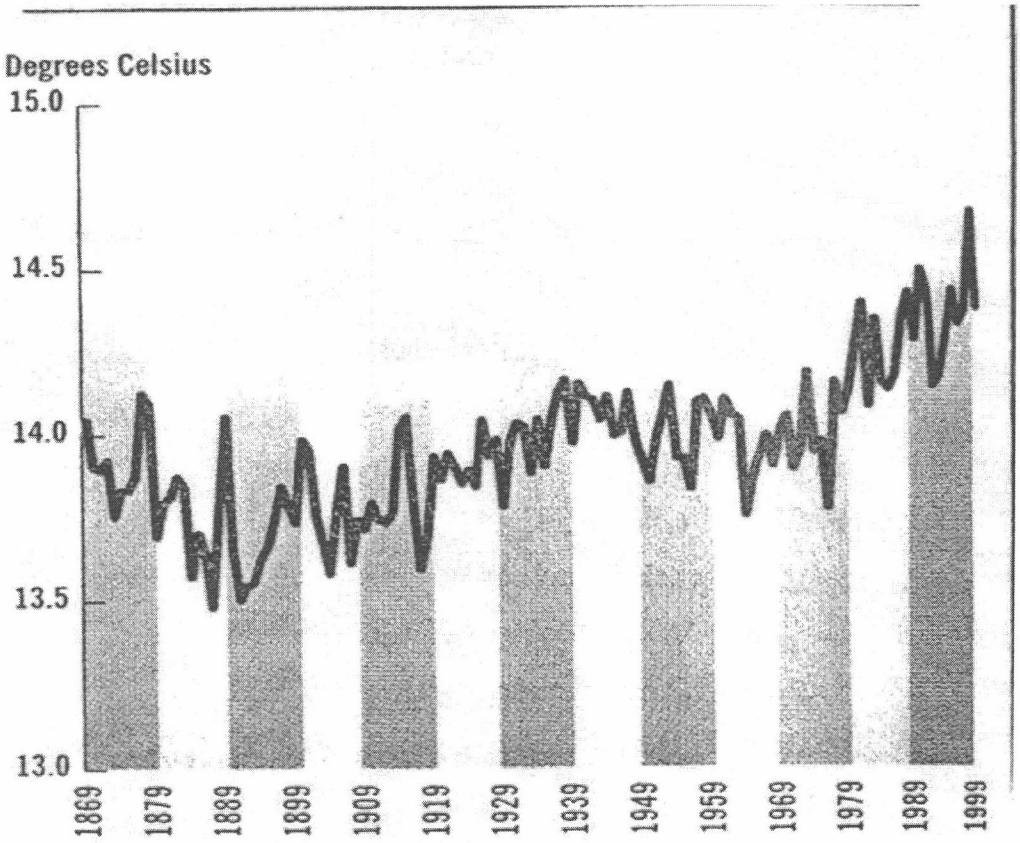
Table 7-3 CO2 Emissions in Poland in the distinguished sectors of the economy over the period of 1988-2001 [million tones of $CO_{2\,eq}$/year]

Specification of categories of CO_2 emissions	1988	1990	1996	1998	2000	2001	2001/1988 [%]
Total national CO_2 emissions (gross), including:	**476.6**	**380.7**	**372.5**	**337.4**	**314.8**	**317.8**	**66.7 %**
Combustion installations in the energy sector:	252.9	234.6	182.0	168.7	164.7	166.9	66.0%
Emission in the processing industry, of which:	82.0	63.3	90.0	83.4	71.7	64.3	78.4%
refineries and coking plants	5.4	4.1	6.4	9.7	7.2	6.6	122.2%
process emissions (from raw materials)	13.6	9.2	8.9	10.5	12.3	10.5	77.2%
Transport	28.2	29.1	28.1	28.1	28.2	30.1	106.7%
Commerce, services, households, agriculture	111.2	55.7	64.1	50.1	45.4	50.1	45.0%
CO_2 removals by sinks (agriculture and forestry)[1)]	**-34.7**	**-44.7**	**-42.6**	**-42.6**	**-43.1**	**-53.6**	**154.5%**
Total national CO_2 emissions (net)	**441.9**	**336.0**	**329.9**	**294.8**	**271.7**	**264.2**	**59.8%**

1)The analyses of CO2 removals by sinks which were performed by 1988 – 2001 used a different methodology. This change is not reflected here.

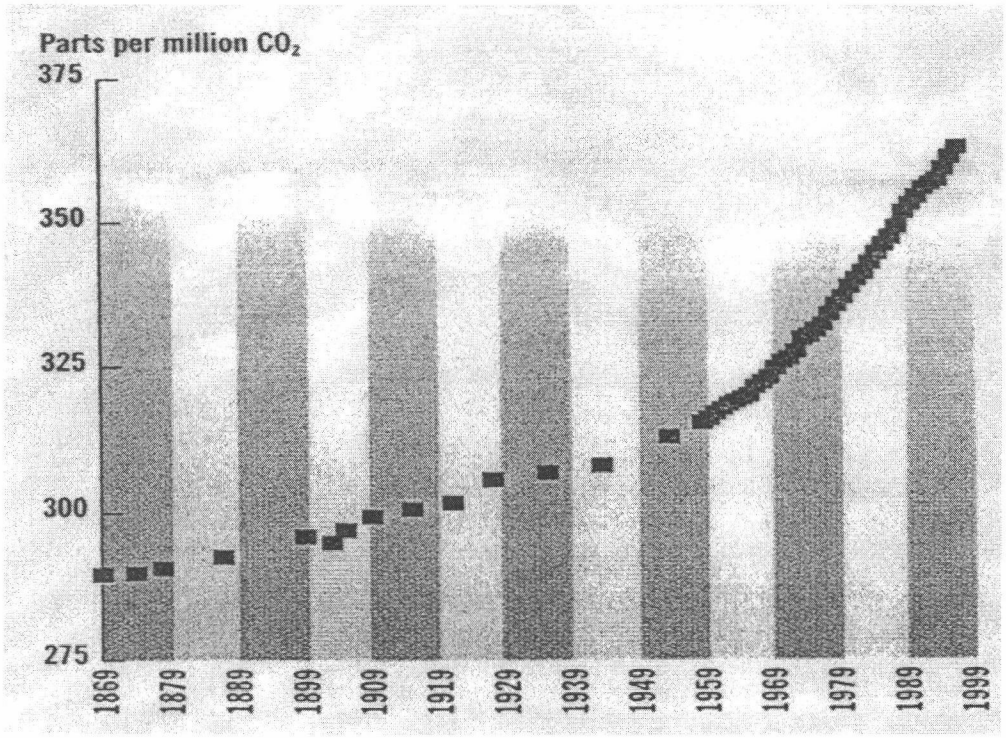
Source: The analysis by EnergSys based on the GHG inventory report for 2001, IOS, Warsaw, 2003 and Third National Communication to the Conference of the Parties to the United Nations Framework Convention on Climate Change, Warsaw,2001.

Figure 1-1 Global Average Temperature at Earth's Surface from 1869-1999



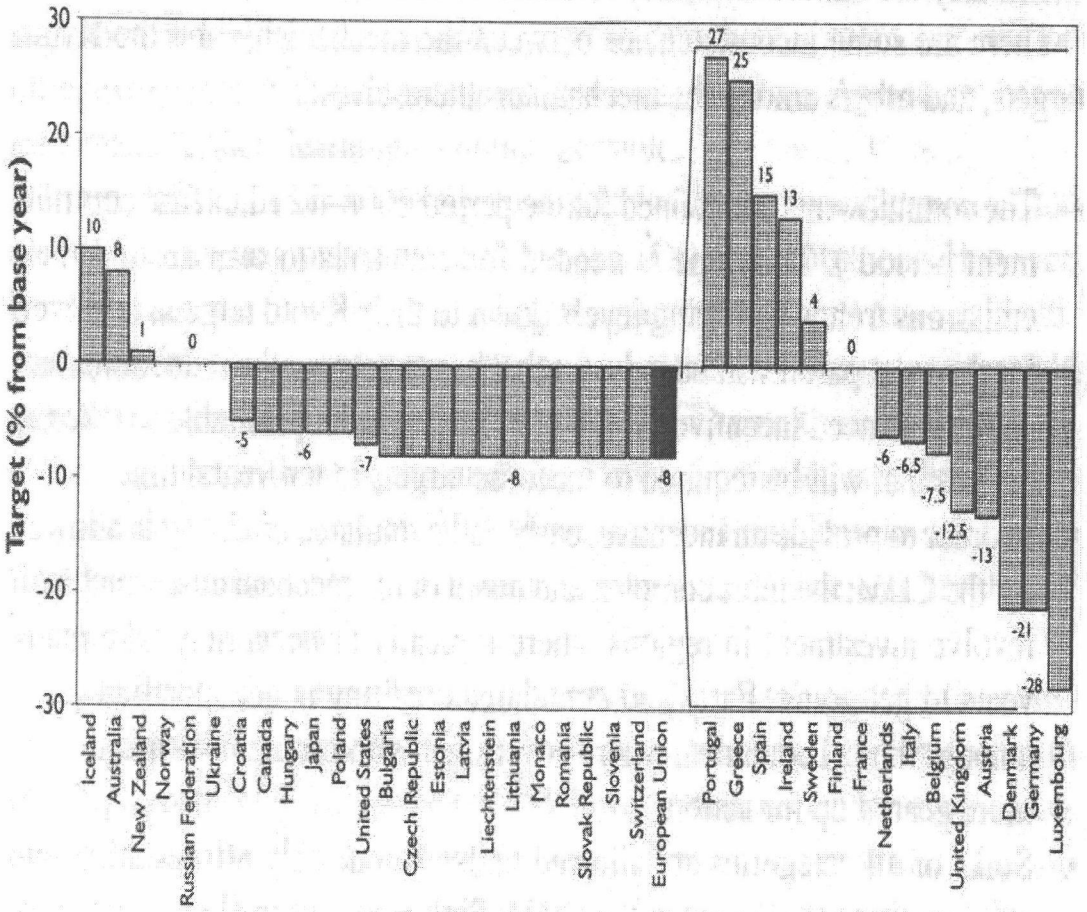
Source: CO_2 information analysis center. NASA's Goddard Institute

Figure 1-2 Atmospheric Concentration of CO_2 Emissions (1869 -1999).



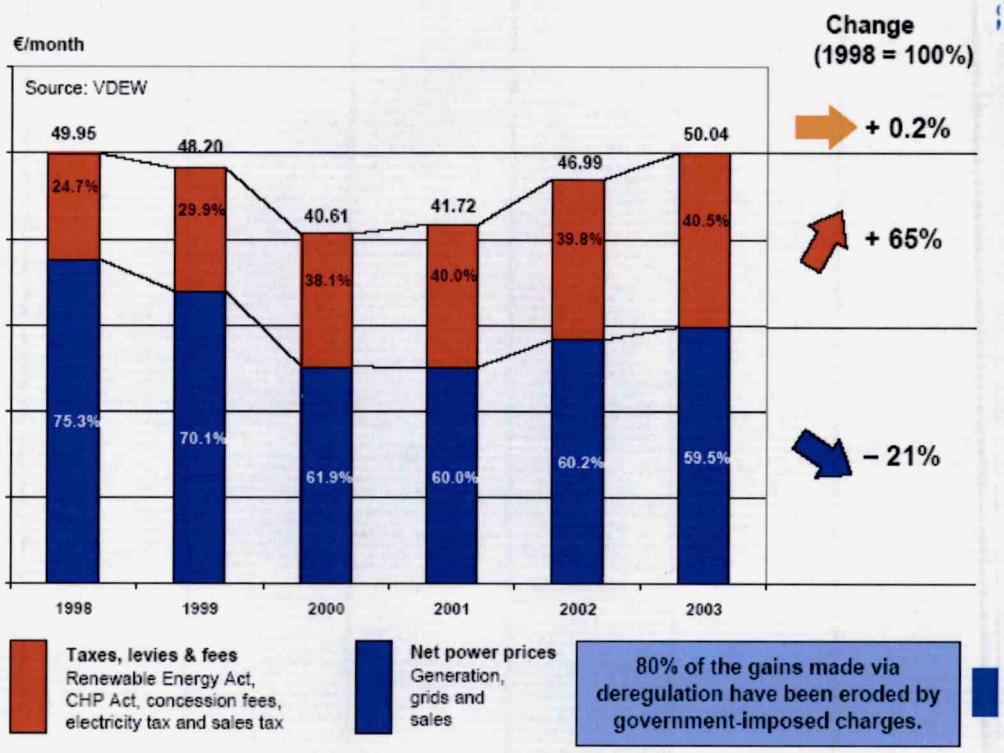
Source: CO_2 information analysis center. NASA's Goddard Institute

Figure 3-1 EU Emissions Bubble Target Compared with Annex B Targets



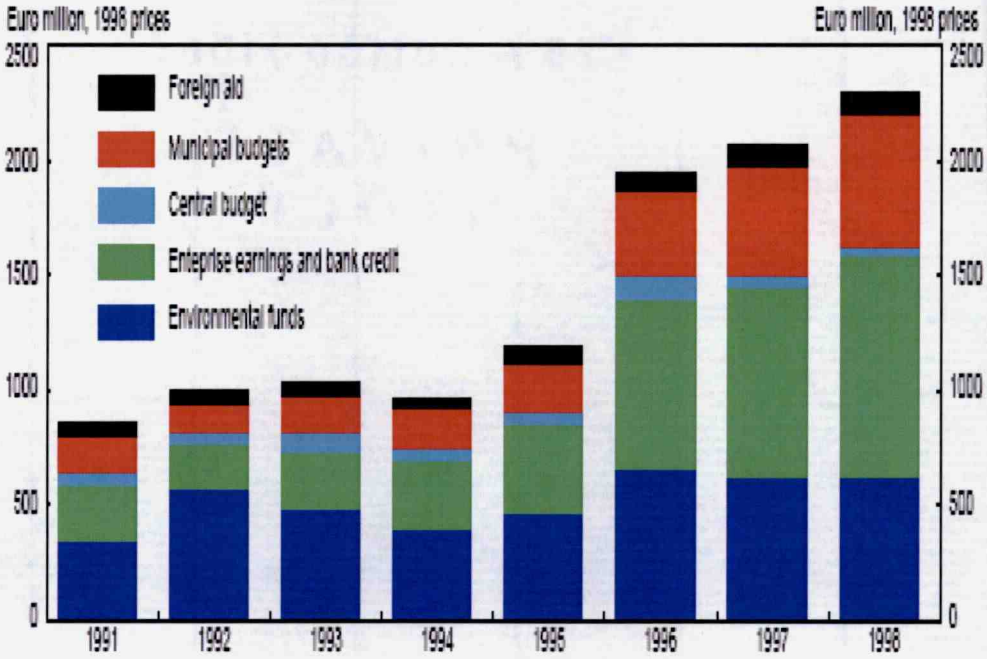
Source: Vrolijk, 2002

Figure 4-1 Average Monthly Electricity Bill of a Three-Person Household (3500kWh/a)



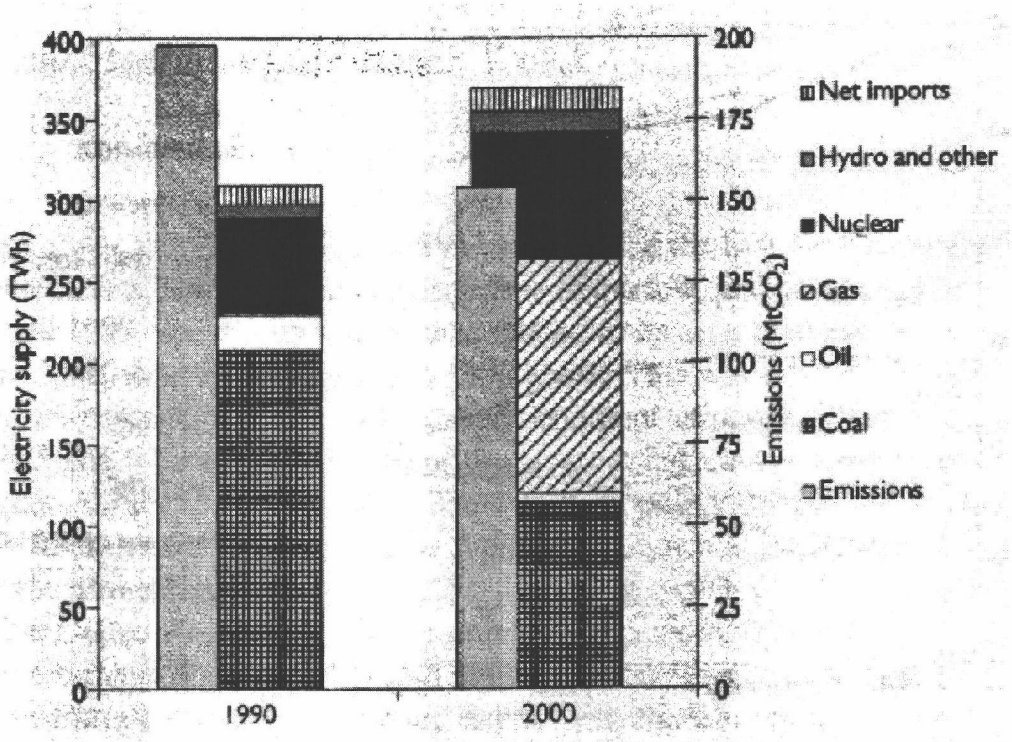
Source: VDEW

Figure 5.1 Environmental Investment Expenditures in Poland by Source of Financing



Source: Central Statistical Office, 2000

Figure 7-1 Power Sector Emissions and Fuel Usage, 1990 and 2000



Source: *UK Energy in Brief* (London: DTI, July 2001); see www.dti.gov.uk/energy/index.htm.

Figure 7.2 Percentage Change in Aggregate GHG Emissions from Selected OECD Countries in CO2 Equivalent from 1990 Levels by 2000