The Effects of Regulatory Threats and Strategic Bargaining on Firms' Voluntary Participation in Pollution Reduction Programs

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Introduction

After years of intense debate, global climate change has finally been acknowledged as a serious threat to global biological, political and economic systems. There is overwhelming evidence that the atmospheric warming observed over the course of the past 50 years, as well as the increasing incidence of extreme weather events and floods, is being caused by the acceleration of the rate in which greenhouse gases (GHGs) produced by the burning of fossil fuels are being released into the atmosphere (IPCC: 2001). The extreme weather and weather-related events associated with climate change, such as landslides and flooding, totaled roughly $40 billion in the 1990s (IPCC: 2001-b, 13). It is not surprising, then, that the governments of many developed and developing nations, as well as intergovernmental bodies like the United Nations and the World Bank, have adopted a variety of measures to reduce GHG emissions and mitigate the potential impacts of climatic change. The government of Slovakia sold credits for 200,000 metric tons of carbon dioxide equivalents to a Japanese trading house at an undisclosed price on December 6, 2002, making history by signing the first deal to be officially credited within the international Kyoto Protocol, a global agreement to reduce the GHG emissions of participating countries seven percent relative to their 1990 levels by 2010 (Gardner: 2002). Nor is it surprising that environmental interest groups and active citizens in the United States and elsewhere are pressing their elected leaders to pass stricter regulations on the emission of GHGs.

What is somewhat baffling, though, is the number of privately owned companies that have taken it upon themselves to voluntarily reduce GHG emissions as a way to address climate change in recent years. Dozens of companies are voluntarily participating in the design and implementation of GHG emission reductions programs.[1] For example, the International Emissions Trading Association (IETA) lists 47 international members including Gaz de France, British

Petroleum, Shell International Limited, Norsk Hydro and Unocal.[2] Private for-profit groups like the Chicago Climate Exchange (CCX), a pilot emissions reduction credit (ERC) trading program, and CO2e.com, Cantor Fitzgerald's online emission trading market, are forming partnerships with private companies to devise strategies for reducing emissions in the quickest and most cost-effective manner. Government programs like the Greenhouse Gas Emissions Reduction Trading Pilot (GERT) in Canada and other programs in France and the United Kingdom are forming similar partnerships. Nonprofit environmental groups like Environmental Defense and the World Wildlife Fund have their own, similar pilot projects. Most of these voluntary programs are centered around emissions trading, a policy tool commonly utilized for its cost effectiveness and ability to yield abatement results.

It is unexpected for a firm to voluntarily reorganize its operations, design and implement new policies and practices, retrain existing staff or hire new staff or purchase pollution-control devices because such actions impose additional costs on the firm if mandatory pollution-control legislation does not exist (Welch *et. al.*: 2002). A stable climate is a public good: it is non-excludable, and is therefore able to be used or abused by anyone. The expenditures of private firms, on the other hand, are usually made to produce goods that are sold and bought for private profit. Pollution, the inevitable byproduct of business, is known as a negative pecuniary externality in economic terms, meaning that it has negative effects on a third party, i.e., society at large, that are not fully accounted for in the price of the company's product. Environmental regulation is enacted to protect public goods like air and water by reducing the incidence of negative externalities with taxes, fees, technological requirements and other measures designed to force a firm to internalize the social costs of production. A company whose actions fall under the jurisdiction of governmental regulation must privately bear the costs of protecting public goods, although those costs are passed on to consumers whenever possible. On the other hand, if laws regulating the emission of carbon dioxide and other GHGs do not exist, as is presently the case in the United States, then a company does not need to spend revenues on pollution control. Herein lies the heart of this paper: why would a rational, profit-maximizing company voluntarily comply with, or help to design, a program intended to impose limits on GHG emissions to avoid the public "bad" of climate change? By doing so, a company is, theoretically, voluntarily internalizing some or all of

the negative external costs associated with GHG pollution. In other words, the company is imposing costs on itself to come into compliance with voluntary rules, and may even have to pay enforcement penalties if the rules are not obeyed. From the standpoint of a cost-benefit analysis, an *un*regulated firm must see some *private* benefit to these additional expenditures, unless the firm is acting in a completely altruistic manner. Ruling out total altruism, the private benefits of voluntarily reducing GHG emissions or participating in the design process of an emissions reduction policy or program must outweigh the costs for those firms that choose to voluntarily take action.

This paper is an investigation into how the private benefits of engagement in GHG abatement projects and qualitative background elements are perceived by profit-maximizing firms, and of how and why firms decide to voluntarily improve their environmental records and, therefore, mitigate the impending threat of global climatic change. Particular attention is paid to the factors that might prompt a firm to voluntarily reduce its emissions through participation in a model or pilot GHG allowance or credit trading system like GERT, CO2e.com or the CCX. Chapter One explains the theoretical underpinnings of general voluntary participation as they apply to individual firms, with supporting evidence from the emerging participation in GHG abatement programs. This section of the paper presents the hypothesis that a rising threat of *mandatory* regulation affects firms' perceptions of the costs and benefits of *voluntary* emissions reductions. The threat of mandatory rules in the future manifests "new" benefits and changes the relative size of existing benefits for firms considering voluntary abatements. Chapter Two lays out the structure of a voluntary chemical use and release mitigation program called the 33/50 Program (henceforth: Program), which the U.S. Environmental Protection Agency (EPA) ran from 1991 to 1995, and existing theoretical and empirical models of the strictly economic and financial factors that contribute to a firm's decision to participate in that Program. Next, Chapter Three presents and describes an empirical model of state-level participation in the 33/50 Program that is used to quantitatively examine the regulatory, political and economic factors that promote or discourage voluntary participation. The empirical model examines how public sentiment and the relative bargaining powers of private manufacturing industries within a state and public governmental bodies work to affect participation rates among polluters in each state, as well as how economic factors like unemployment rates, average manufacturing firm size and the structure of a state's economy impact Program participation rates. The results of the empirical model appear in Chapter

Four, as does the analysis of the model. In Chapter Five, lessons are drawn from the empirical analysis to shed light on the current state of the GHG emissions abatement programs and trading markets. The policy implications of the findings are discussed in Chapter Five, and specific recommendations made as to how to promote participation in voluntary GHG abatement programs. The empirical evidence, together with the underlying political-economic theories, suggest that the threat of impending mandatory regulation can make voluntary participation seem increasingly desirable to firms, but that actually attempting to impose those laws would force the regulator into a strategic bargaining game with firms. Rather than enter into this game, which must be played to induce some firms to install equipment for compliance that costs more than the penalties under a command-and-control regime, the costs of compliance, either voluntary or mandatory, can be lowered significantly by instituting an emissions permit trading system. By providing incentives for compliance rather than disincentives for noncompliance, smart policy-makers can promote emissions reductions at the lowest possible cost to firms and society.

Chapter One

The Theoretical Underpinnings of Voluntary Participation

There is a sizable body of theoretical and empirical literature that studies firms' motives for voluntary participation in programs that yield environmental and social benefits. A firm must gauge the costs and benefits of voluntary compliance before it makes the participation decision. A number of economists, including Aseem Prakash, Seema Arora and Timothy Cason and Robert Baylis, Lianne Connell and Andrew Flynn cite a variety of categories of costs and benefits of voluntary compliance with environmental programs. The biggest potential costs could come from new capital equipment, employee retraining, financial market fluctuations and, of course, the opportunity costs of the funds used for development of and compliance with voluntary programs. Potential benefits include savings realized from enhanced operating efficiency, goodwill from shareholders, consumers, and other concerned communities and preempting mandatory regulation and thereby getting a jump on competitors. The magnitude of potential costs and benefits are primarily determined by two things: the level of the threat of mandatory regulation a company believes to exist and the type of voluntary program being implemented. Certain benefits and costs change in size depending on these two variables. Therefore, in order to get a better handle on theories behind voluntary pollution mitigation and GHG abatement in particular, this paper begins with an explanation of the background level of regulatory threat perceived by relevant firms and then explains how emissions trading systems work and why they are the most likely candidates for policy tools if mandatory emissions abatement legislation is adopted in the United States. With the political background in place, the potential benefits and costs of voluntary participation in pollution abatement programs can be discussed. Each of these topics has its own section below.

The Threat of Legislation

Regulation of GHGs in the name of climate change is a relatively new policy area, but it is also a fast-growing one. The Kyoto treaty requires each participating country to devise its own emission reductions strategies in order to reach compliance with the global abatement agreements.

Sixteen nations have either mandatory or voluntary GHGs reduction programs, and some, like the Netherlands and Canada, have more than one program in operation. In addition to these domestic programs, the European Union, the World Bank and North American Free Trade Agreement (NAFTA) countries are developing their own abatement policies and programs.[3] Roughly 5,000 companies face emissions control legislation from the European Union (Fialka: 2002).

Given the evolution of GHG emissions control policy in the past decade, it seems reasonable to conclude that domestic and international policy could be drivers behind many firms' decisions to voluntarily reduce emissions of GHGs. Indeed, this hypothesis is supported by evidence from the investment industry as well as groups that are trying to establish voluntary trading programs in carbon equivalent credits, like the CCX, and theoretical literature. According to John S. Guttmann, a commercial environmental attorney, companies that stand to be affected by environmental regulation, "are always on the lookout for trends that will be of importance to the regulated community, regulators, and the public" because those changes tend to lead to environmental regulation (Guttmann: 1998, 82). Guttmann notes that globalization and public participation in the regulatory process are two recent trends pushing environmental policy. Massive globalized manufacturing corporations will play a critical role in international GHG abatement schemes, and publicly available documents like the U.S. EPA's 1990-2000 Inventory of Greenhouse Gas Emissions and Sinks empower citizens to question corporations' environmental policies (or lack thereof). Citizen and other stakeholders' action will be discussed toward the end of this chapter, but it should be noted now that people who believe themselves to be stakeholders in a corporation in one way or another significantly push companies to improve their environmental records (Foulon *et. al.*: 2001; Prakash: 2002; Henningsen: 2002; Knoepfel: 2001).

Cantor Fitzgerald's satellite group dedicated to carbon trading, CO2e.com, reports that companies are already engaging in market transactions of carbon credits, and will do so even more in the future as a way to hedge their exposure to expected regulations and mandatory abatement of GHG emissions.[4] PriceWaterhouseCoopers provides the consulting services to CO2e.com's customers through Climate Change Strategic Services, a specialized advisory service. The Service provides companies with background scientific, political and regulatory analysis that helps customers devise strategies to maximize profitability in an uncertain future business environment.

Climate Change Strategic Services emphasizes, "testing the business plan for climate change impact," and operates under the assumption that, in the future, companies will have to operate, "in a carbon constrained world."[5] According to a study by the World Bank and a New York-based energy and environmental consulting and trading firm called Natsource LLC, carbon trading is estimated to have quadrupled in 2002 compared to 2001. The World Bank estimates that between $350 and $500 million in carbon dioxide emissions trades have taken place since 1996 (Fialka: 2002). Jack Cogen, the president of Natsource, is quoted in a Wall Street Journal article as saying, "'If you're a company and you're looking toward the future, you may see a large liability looming'" (Fialka: 2002). The liability is in reference to international and domestic (non-U.S.) GHG regulatory systems that are supposed to go online within the next few years. This feeling is echoed by Mike Walsh, senior vice president of Environmental Financial Products LLC, the firm organizing the CCX. Walsh says, "there's a one-hundred percent probability of policy [change]. It's a matter of when" the regulations will be imposed (Walsh: 10/24/02). The Exchange announced its fourteen founding members in January of 2003.[6]

Even members of the petroleum industry - the industry that provides fuel to millions of polluting internal combustion engines around the world - believe that regulation of GHGs, particularly the GHGs in fossil fuels, is soon to be a fact of life. Lord John Browne, the CEO of BP, believes the U.S. government will regulate GHGs in the near future in spite of President Bush's refusal to sign the Kyoto treaty. Moreover, Browne, like a number of other corporate leaders and business analysts, believes companies that pre-empt mandatory regulation by voluntarily mitigating harmful atmospheric impacts will not only gain competitive industry advantage, but will also "'gain a seat at the table, a chance to influence the rules'" (Frey: 2002).

Kathleen Segerson and Thomas J. Miceli study the role that background regulatory threats play in inducing firms to participate in theoretical, generic voluntary pollution reduction programs in their paper, "Voluntary Environmental Agreements: Good or Bad News for Environmental Protection?" They look at how different theoretical scenarios for the relative bargaining powers of a firm and a regulatory body affect voluntary pollution abatement outcomes. Neither the type of pollution nor the type of voluntary program are specified. They find that, in their model, a firm will *always* accept a voluntary agreement if the possibility of legislation is greater than zero. They also

find that, if the threat of regulation is high enough, the aggregate level of abatement will be higher under a voluntary program than it would have been if an abatement level had been imposed legislatively. Moreover, since compliance costs are lower under a voluntary program, a firm might even accept a higher level of abatement than would have been agreed upon if the program were mandatory. However, if the firm has all or most of the political bargaining power, then the level of abatement reached under a voluntary agreement will be lower than the best possible level, i.e., the maximum level of abatement that could have been reached voluntarily if the regulator had had the majority of the bargaining power. For weak regulatory threats, the voluntary agreement would be negotiated, but the level of abatement would not be as high as it would have been if the regulator had more bargaining power (Segerson & Miceli: 1998, 128).

Segerson and Miceli also learn that, if the level of policy threat changes over time, the firm's incentive to enter into a voluntary agreement will change as well. This means that the maximum level of abatement a firm is willing to undertake will change as the probability of legislation changes (Segerson & Miceli: 1998, 115). Their results indicate that voluntary actions which protect the environment depend, among other things, on the relative level of regulatory threats, which in turn depends on the political bargaining powers held by private (industrial) and public interests. The results of their theoretical model have consequences in the public policy realm, and the empirical model in *this* paper include independent variables that proxy for the relative bargaining powers of private firms, the relevant regulatory body and the general public.

Emissions Trading Programs

Most of the policy tools that governments and international governing bodies like the European Union have adopted for GHG abatement are centered around permit or emission reduction credit (ERC) trading, in which agents are allowed to trade and bank permits to comply with regulation.[7] Emissions trading harnesses market forces to reduce pollution in a cost-effective and efficient manner. Trading is considered to be more flexible than command-and-control environmental regulation because each firm is allowed to choose whether it reduces emissions internally or buys emission reduction "credits" from other firms that have reduced emissions

below the required level and therefore have excess credits to either bank or sell. A rational firm will choose the least-cost method of compliance with the emissions cap.

A successful example of such a program is Title IV of the 1990 U.S. Clean Air Act Amendments, which employs a cap-and-trade system to regulate emissions of sulfur dioxide (SO_2) and nitrogen oxides (NO_X). The Acid Rain Program, as Title IV is known, has been deemed successful by legislators and economists because of the significant reductions in SO_2 and NO_X emissions - 33 and 25 percent lower in 2001 than in 1990, respectively.[8] Even regulated utilities prefer the market-based system over a command-and-control system because costs are relatively low (Tietenberg: 2000; Stavins: 1995). The Kyoto Protocol employs an international permit and offset trading system to help countries achieve compliance at the least possible cost. The majority of countries participating in Kyoto that have already begun to design domestic compliance policies, including Australia, Germany, Norway and the United Kingdom, plan on using mandatory or voluntary internal emissions trading systems.[9]

The Potential Benefits of Voluntary Participation

The cost effectiveness of trading schemes, and the high likelihood that future U.S. regulation will employ a cap-and-trade system like the one used in the Acid Rain Program, probably explains a good deal of firms' motivations for engaging in voluntary emissions trading and the design of carbon markets. First, firms could potentially see large savings from improved operating efficiency spurred by participation in a voluntary abatement program, particularly if that program allows for ERCs to be sold on an exchange. There are at least three specific reasons why a company would want to preempt future environmental regulation by voluntarily reducing harmful environmental impacts: the firm could gain competitive advantage and first-mover advantage in the future; reductions now could be recognized under future regulation; and overseas industry pressure, especially among multinationals and under the Kyoto Protocol, would be diffused. The economic literature also gives at least four reasons for a company to voluntarily reduce its emissions that do not necessarily have to do with preempting mandatory regulation, but the results may be amplified by participation in a voluntary program. Three of these benefits are related to obtaining the

goodwill of a company's stakeholders, and one of which is, like enhanced operating efficiency, a business strategy that tends to increase short- and long-term success for a variety of reasons. The stakeholder benefits accrue from shareholder or investment market goodwill, consumer goodwill and community goodwill. Each of these categories of benefits to voluntary action are outlined in detail in the following paragraphs.

Improved Energy Efficiency

Basic economic theory states that a manufacturer (or any other economic agent) should try to get the most output possible from a given amount of input - this is efficiency. Fuel to run the production process is an input, and a profit-maximizing company will consume as little energy per unit of good produced in its production processes as the relative costs of fossil fuels and their substitutes dictate - this is energy efficiency. Despite the rationale, many firms operate below maximum energy efficiency. Part of the problem is a lack of technical energy use expertise and the absence of an aggressive strategy for reducing inefficiencies within the firm. Another obstacle is the potentially high cost of energy-saving capital improvements. It might not make sense for a company to upgrade all of its operations in one fiscal year, but it would be sensible for a forward-thinking firm to replace retired capital equipment with energy-efficient substitutes, because then the "upgrade" would only be the marginal cost of the more efficient equipment, if the more efficient equipment is in fact more costly than other new equipment. Moreover, annual savings from reduced energy use could be factored into the capital purchasing decision. The benefits of improved energy efficiency would increase if regulation on carbon emissions were adopted - or if a firm were to choose to join a voluntary emissions trading program, in which the firm could either bank or sell accrued emission reduction credits. Every ton of carbon dioxide equivalent could be applied toward compliance, and additional tons kept out of the air could be sold as ERCs. Under a trading regime, a company can save money in its production processes *and* potentially generate income by selling its excess ERCs to firms that cannot reach compliance.

Eventually, regulations on carbon emissions should bring the private costs of generating emissions in line with the public costs, as that is the general goal of legislation aimed at internalizing costs that are "external" to the firm. Various types of regulation, such as tax systems, emissions caps and command-and-control, can be used to drive companies to internalize the

negative social externalities of their operations (Hobbs & Centolella: 1995). Firms that are said to be going "beyond compliance" impose these or similar additional costs on themselves (Prakash: 2001). If a firm that has been forced to internalize the GHG-related social costs associated with its operations wishes to remain competitive, then reducing the amount of pollution produced per unit of output can help a company achieve compliance and reduce overall operating costs. However, it should be noted that a company may see a benefit to joining an ERC trading system and registering its current level of emissions *before* improving its operating efficiency and reducing emissions. According to the theory of decreasing marginal returns to energy efficiency investments, the marginally least expensive reductions will be the initial ones, so it would be wise to tie initial efficiency-related abatements in with a trading program in order to receive ERCs for those relatively "cheap" reductions. Receiving long-term bankable permits for baseline emissions reductions might not be the best possible strategy for mitigating the threat of climate change, but it is a valid motivation for a firm's voluntary participation.

Benefits Related to Potential Regulation:

Competitive Advantage in the Future & First-mover Advantage

It follows from the previous discussion of regulatory threat that preparation could be the key to business success in an uncertain future. Adjusting policies and operations in anticipation of regulatory shifts puts a firm at a competitive advantage in terms of being able to cost-effectively cope with new new abatement demands. Mike Walsh of the CCX and others explain that those firms which already have the framework for reducing emissions in place, as well as trained staff, will be better positioned to navigate the new regulatory field than those firms that operate under the mindset that business will always be business as usual.

Some companies set strict environmental performance standards and policies for themselves as a form of business discipline. Electrolux, for example, sees the ultimate goal of "sustainability" as "central to its business strategy and as a source of competitive advantage" (Henningsen: 2002, 167). The commitment to sustainability sets Electrolux products apart from those of competitors, and forces the company to take an active, involved role in its production process, which could help

bring various inefficiencies to light. Similarly, BP CEO John Browne, possibly the most high-profile example of corporate environmental leadership, sees investment in photovoltaic (PV) production and the formation of symbiotic partnerships with local governments and non-governmental organizations as investments that will serve the long-term interests of the company. For example, BP is a participating member of the Environmental Defense's emission permit trading group, among others, and has pledged $1 million to the Nature Conservancy of Canada for habitat conservation.[10] Browne sees increased demand for PV power in the future as energy markets are deregulated, as energy provision becomes privatized, and as the U.S. government provides additional incentives for consumers to use renewable power. Moreover, he thinks that subsidies will someday be removed from fossil fuels (Lowe & Harris: 1998). Oil, natural gas and coal companies are given billions of dollars annually in tax write-offs for exploration, developing and drilling costs, and taxpayer funding for "clean coal" research and Export Import Bank guarantees on investments in "unstable" countries.[11] Being prepared for changes in the political realm, he and other business leaders reason, will serve the long-term competitive interests of the company.

Anticipating more stringent regulation could yield even greater returns if a company is among the first in its industry to bring its operations in line with the expectations of future policies. Aseem Prakash, Assistant Professor of Political Science at the University of Washington in Seattle, writes that there are two main reasons why pre-empting regulation would prove beneficial: it could raise the cost of entry into the industry and put first-movers in a position to shape official public policy (Prakash: 2002). According to some researchers, technologically advanced firms would be the most likely to adopt green practices anyway, since they already have the infrastructure for compliance in place. These firms could take further advantage of their position by pressuring the rest of the industry to reduce environmental impacts, or by lobbying government to pass legislation that would make certain "best available control" technologies - technologies monopolized by these research-intensive firms - mandatory (Prakash: 2002). Firms that take leadership roles in their respective industries are in a position to determine the course and nature of regulation; this goes for firms that lead in the realm of environmental responsibility as well. Mike Walsh believes that the government will soon begin to look for ways to regulate GHG emissions, and that the CCX will be an obvious resource, since the Exchange will have already tested a domestic ERC trading system.

Walsh suggests that this potential for shaping public policy is part of a firm's motivation in joining the design phase of the CCX (Walsh: 10/24/02).

Recognition Under Future Regulations

The benefits of engaging in voluntary pollution abatement would be reduced if present actions, and documented emissions reductions, were not going to be recognized under the expected future regulatory regime. The people at the cutting edge of the emissions trading market are confident, though, that documented emissions reductions will get credit for early action under future policy (Walsh: 10/24/02; CO2e.com; CCX PowerPoint). Moreover, as was previously explained, it is highly likely that future GHG legislation will take the form of a cap-and-trade system. The aforementioned energy efficiency improvements are most beneficial to a company if the reductions are recorded in a legitimate registry of some sort.

Overseas Industry Pressure

One of the arguments used by representatives from the United States in refusing to sign the Kyoto standards into domestic law is that the international treaty would put American companies at a competitive disadvantage with the rest of the world. The argument states that the goods produced by U.S. firms would have to be priced higher than goods produced abroad if U.S. firms face tighter regulations on environmental health and safety, wages, etc. than foreign firms, and that U.S. goods would therefore be priced out of the market. International trade treaties take into account the uniformity of manufacturing environmental and workers' rights standards in some cases, and ignore it in others. Now, with the Kyoto Protocol set to go into effect in the very near future, American companies will face a different and *less* environmentally stringent set of regulations from those in most other parts of the developed (and some of the developing) world.[12] Multinational companies will be subject to local domestic GHG regulations, and it could be in their best interests to employ some sort of internal emissions trading program like the one used by BP in order to meet the domestic abatement standards.[13] If a company's U.S. operations are not included within the Kyoto framework, however, internal abatements that involve U.S. facilities cannot be recognized, and overall abatement might therefore be less cost-effective. Mike Walsh says there will probably

be international, intracompany trading with the CCX, which could be another reason for U.S.-based companies to sign on (Walsh: 10/24/02). It could be in the best interests of an international firm to have a compliance strategy that is as flexible as possible, which might include emissions trading. Voluntary participation in a trading system now would prepare a firm's staff to deal with a mandatory system that might come along in the future or, in the case of Kyoto, within months.

Benefits Unrelated to Potential Regulation

Status As an Industry Leader

Corporate leadership, from the CEO, CFO or other top-level managers, is often cited as a major driver in a firm's decision to reduce its GHG emissions by business leaders and academic papers alike (Frey: 2002; Baylis *et. al.*: 1998). Howard Ris, President of the Union of Concerned Scientists, says that "90 percent" of a firm's decision to engage in voluntary environmental protection programs, particularly ones pertaining to GHG emissions and climate change, is determined by the goals or mindset of the CEO (Ris: 12/5/02). Corporate environmental leadership has become almost popular among some large businesses in the past decade. For example, Interface, one of the world's biggest carpet manufacturers, has the ultimate sustainable goals of zero waste and closed-loop production, goals put in place by its corporate leadership (Henningsen: 2002). Deutsche Bank has been involved in the United Nations Environmental Program, the Bellagio Forum for Sustainable Development and the World Bank Prototype Carbon Fund. A spokesman for the bank's Board of Managing Directors, Rolf-E Breuer, is quoted as saying, "'sustainability it not an abstract idea...it is an important element of [our] corporate policy and a significant factor driving [our] business policy decisions'" (Henningsen: 2002, 167).

Once again, oil companies like BP and Shell are jumping on the bandwagon, too. John Browne of BP calls ducking out of responsibility toward the environment, "a failure of leadership" (Frey: 2002). In 1998, Browne committed his company, with current gross revenues of $174 billion, to carbon emission reductions of 10 percent below 1990 levels by the year 2010, a commitment more ambitious than the Kyoto Protocol. His company achieved the goal in 2001, nine years ahead of schedule (Frey: 2002; BP: 2002). The company met its internal standards quickly - and at no net cost to business - by engaging in intracompany emissions trading, that is,

trading ERCs among BP business units around the world (BP: 2002; Frey: 2002).[14] The issue is both a civic and a business one for Browne, who told the *New York Times Magazine*, "Climate change is an issue which raises fundamental questions about the relationship between companies and society as a whole, and between one generation and the next" (Frey: 2002). He also makes the case that what is good for the climate is also good for business, particularly if the regulation he expects comes to fruition. Browne operates with the outlook that fossil fuels will probably be phased out in 30 to 50 years, but that regulation of GHG emissions will come much sooner than that (Frey: 2002; Lowe & Harris: 1998). Today, BP is working with the Pew Center for Global Climate Change, CO2e.com and the IETA to design ERC trading programs.

Shareholder/ Investment Market Goodwill

Company shareholders and other investment market agents can put significant pressure on firms to change their environmental and social actions for the better. A large portion of the literature states that investors can be active in the greening of a company, either through direct shareholder resolution or through the initial decision to invest (Prakash: 2002; Henningsen: 2002; Knoepfel: 2001; Guttmann: 1998). A direct shareholder resolution forced ExxonMobil to divest from the Global Climate Coalition, a lobbying group aimed at delegitimizing climate change (Gelbspan: 2002). More recently, in early December of 2002, a religious group called the Interfaith Center on Corporate Responsibilities filed shareholder resolutions with Ford and General Motors, asking the auto manufacturers to reduce GHG emissions in both its manufacturing plants and its products - cars, trucks and SUVs (ENS: 2002). It is as of yet unclear what effect the resolution has had on the firms' management and operations.

Sometimes investment decisions are based on social and environmental quality indicators not necessarily because the investor cares about workers or the climate, but rather because she wants to make the most possible money off of her investments. According to Ivo Knoepfel, Head of Rating and Index Research at SAMS Sustainability Group and a co-chair of the Global Reporting Initiative's Measurement Working Group, "increasingly, investors use corporate sustainability as a proxy for enlightened and disciplined management" (Knoepfel: 2001). This concept ties in with the notion of corporate leadership discussed above. Certain CEOs echo this

theory, such as Harry Kraemer, Jr., of Baxter International. Kraemer believes that, "'sustainable development provides a framework to create opportunities out of these winds of change,'" and that such changes improve the bottom line and, therefore, dividends (Henningsen: 2002, 167). It is becoming widely accepted in the investment industry that environmental and social screens "add value to the screening process" by providing evidence of strong, innovative and aggressive leadership (Henningsen: 2002, 165; Knoepfel: 2001). According to the Dow Jones Sustainability Group Index (DJSGI), companies listed on the DJSGI had better average returns on equity, investments and assets than companies in the regular Dow Jones Global Index (DJGI) from 1993 to August of 2000 (Knoepfel: 2001, 7).

Economists Jérome Foulon, Paul Lanoie and Benoit Laplante cite three studies which have shown that publicly disclosed information drives increases in market share value when the disclosure is of superior performance, and drives share prices downward when the disclosure is negative (Foulon *et. al.*: 2001, 170). The number of invested dollars illustrates the degree to which shareholders value corporate responsibility indicators, for one reason or another. Over $2 trillion are in socially responsible investments under professional management in the United States. According to Carsten Henningsen of Progressive Investment Management, total U.S. assets in social investments grew 36 percent from 1999 to 2001, over 1.5 times the 22 percent overall increase for all investment assets managed professionally in the same period (Henningsen: 2002).

Consumer Goodwill

Surveys and empirical studies report that consumers look for "green" labels on products and are willing to pay more for such environmentally friendly goods and services (Prakash: 2002; Arora & Cason: 1995; Arora & Gangopadhyay: 1995). Generally, companies that sell goods directly to final consumers focus their advertising on brands and specific products, and are the most likely to claim to be environmentally responsible (Prakash: 2002; Arora & Cason: 1995; Arora & Gangopadhyay: 1995). A 1999 survey found that 50 percent of Americans claim to look for green labels on the products they buy, and to switch brands based on their the firm's environmental record. Not all of these people may be willing to pay the premium price that is often charged for greener products (Prakash: 2002), but economists Seema Arora and Shubhashis Gangopadhyay report that consumer markets are segmented, and that people who value environmental benefits and

can afford them can support a market for "green" products (Arora & Gangopadhyay: 1995). Arora and Gangopadhyay construct a two-stage game theoretical model in which firms decide on the level of environmental cleanliness/ control they will employ, and then compete in prices. They find that, by setting different levels of environmental protection, the firms differentiate themselves and are able to cater to a segmented market in which some consumers are willing to pay more than others for additional environmental benefits. Aseem Prakash, however, examines consumer surveys and finds that, according to a 1991 survey, 47 percent of consumers think that corporate environmental claims are "gimmicks" (Prakash: 2002). Mandatory public reporting of pollution enables consumers to see the differences between the environmental policies of the different firms, if consumers choose to look up the information (Arora & Gangopadhyay: 1995; Prakash: 2002).

Mandatory public reporting of pollution and other environmental impacts, or public disclosure, has been found to be a driver of consumer and investor decision-making. A number of researchers conclude that public disclosure of environmental performance creates strong incentives for a firm to engage in pollution control (Foulon *et al.*: 2001; Arora & Cason: 1995; Arora & Gangopadhyay: 1995; Guttmann: 1998). Public disclosure and the impact of community "right-to-know" laws on firm environmental performance are discussed in the following section.

Community Goodwill/ Right-to-Know

Community goodwill is perhaps the broadest category of goodwill because the actors are not as clearly defined as they are in the shareholder and consumer goodwill categories. In fact, shareholders and consumers can be considered part of the greater community that comes into contact with a given firm, its products and its pollution. According to John Guttmann, environmental organizations and community members see themselves as "stakeholders" in the polluters' operations, and feel they have a right to know about environmental infractions and a right to be involved in the regulatory process (Guttmann: 1998, 85).

Paul Wapner writes about grassroots community activism in his essay, "Politics Beyond the State: Environmental Activism and World Civic Politics," and concludes that transnational environmental activist groups like Greenpeace and the World Wildlife Fund politicize societies, or motivate citizens, by bringing "hidden" or unknown environmental abuses to the surface (Wapner: 1998, 515). This politicization yields significant positive results in many cases. Motivated citizens

are often rallied into a boycott of a certain offending product or company (non-dolphin-safe tuna and McDonald's styrofoam hamburger containers are two classic examples), and the community/ consumer/ citizen groups are often successful in bringing about changes in corporate policies, at least at the visible level. Greenpeace, for example, is currently organizing boycotts of ExxonMobil gas stations because of ExxonMobil's refusal to address climate change. A *Business Week* article on environmental activism by Laura Cohn and Heather Timmons notes that a Deutsche Bank report on ExxonMobil states, "'Being handed a reputation as environmental enemy No. 1 for such a big customer-facing business has to be considered a brand risk'" (Cohn & Timmons: 2002). The same article quotes Phil Capp, the President of a Washington, DC-based lobbying group, as saying, "'Companies are very sensitive to anything that would put their brand name in a bad light,' (Cohn & Timmons: 2002). It is evident from these and other anecdotes, as well as empirical tests, that activist groups can put pressure on corporations by mobilizing communities.

Citizens do not just rely on Greenpeace to inform them of environmental damages in their neighborhoods, though. Community right-to-know sources like the U.S. Greenhouse Gas Inventory and the Toxic Release Inventory (TRI), a mandatory self-reporting system for over 320 chemicals that was established in 1988 to track release and transport of toxic materials, are relatively accessible public databases that list the toxic releases and transfers, GHG emissions and other environmental damages of individual companies and/or operating facilities. Both Mike Walsh of the CCX and attorney/ author John Guttmann believe that expansions of these and other right-to-know laws, and the attendant direct public involvement in the oversight of both large and small corporations, are becoming regulatory drivers (Walsh: 10/24/02; Guttmann: 1998). Foulon *et. al.* conducts an empirical analysis of the relative impact of "traditional enforcement" and information strategies (public disclosure) in pollution control undertaken by a firm, and conclude that, "...evidence that the public disclosure of environmental performance does create additional and strong incentives for pollution control" (Foulon *et al.*: 2001, 169). The researchers also find evidence that appearing on a public list of polluters has a stronger impact on firm behavioral changes than do monetary fines (Foulon *et al.*: 2001, 185).

Robert Baylis, Lianne Connell and Andrew Flynn look at the relationship that company size and existing regulations have on a firm's perceptions of the stimuli that drive them to improve their environmental records, and come to a similar result in their paper, "Company Size, Environmental

Regulation and Ecological Modernization: Further Analysis at the Level of the Firm." They conclude that social responsibility is a significant driving factor in a firm's decision to improve its environmental record (more so among large companies than among small-to-medium enterprises), and that local communities can influence industry (Baylis *et. al.*: 1998). With the amount of media attention that climate change, ratification of the Kyoto treaty and domestic non-involvement in the entire global political process have received in recent months, it would not be surprising to learn that citizens are beginning to take into account the climatic impacts of the companies they typically patronize, much like Greenpeace has done with ExxonMobil.

These are significant findings, because they indicate that community activism can influence company behavior as much as - or even more than - government-sanctioned regulation. Expansion of community right-to-know programs could drive companies to "voluntarily" mitigate their negative environmental impacts. Not every community is made up of empowered and vocal citizens, though, as a 1996 study by Seema Arora and Timothy Cason illustrates, entitled, "Do Community Characteristics Determine Environmental Outcomes? Evidence from the Toxic Release Inventory." Arora and Cason look at toxic releases from the TRI database, voter turnout and socioeconomic, gender and racial factors to test the significance of each of these on the environmental performance of polluters in thousands of designated geographic regions around the United States. Overall, they find that the variables presumed to affect the likelihood that communities will engage in political action, including voting, significantly increase environmental performance. These variables include higher education, carpooling to work, having kids, employment in manufacturing industries, median age and percentage of residents renting their primary residences (Arora & Cason: 1996). They also conclude that economic variables significantly impact toxic releases: poorer neighborhoods have higher rates of toxic releases, and very wealthy neighborhoods have the least (Arora & Cason: 1996).[15] These results are important because they indicate that there could be geographic or demographic aspects to firms' environmental performance. It also means that "policy threats" could include civil action as well as government mandate, and variables contributing to an active citizenry should therefore be incorporated into any empirical study of voluntary participation in environmental programs.

Chapter Two

The 33/50 Program and A Firm-Level Model of Participation

The 33/50 Program is a voluntary chemical pollution prevention program that was initiated by the U.S. Environmental Protection Agency (EPA) in 1991.[16] The Program had the goals of reducing the releases and transfers of 17 highly toxic chemicals by 33 percent by the end of 1992 and by 50 percent by the end of 1995. It was a temporary pilot program that only ran from 1991 to 1995, and is therefore not in operation today. Unlike many EPA programs, the focus of the 33/50 Program was on prevention rather than containment or other "end-of-pipe" pollution remedies. The EPA offered the opportunity to participate to 555 companies that had "substantial chemical releases" in February of 1991, and to 5,000 more companies in July of 1991. Over the next three years, 2,500 more invitations were offered to selected facilities (U.S. EPA: 1999). According to the EPA, almost 1,300 companies joined the 33/50 Program. The EPA dedicated most of its outreach to the 600 companies with the largest volumes of releases and transfers, and participation among these companies was 64 percent, versus under 14 percent for the smaller firms. According to the EPA, 1,066 of the 1,294 participants set measurable reduction goals that represented almost a halving of these firms' 1988 releases and transfers (1988 was the baseline year).[17]

There have been a few economic analyses of the 33/50 Program, which has been dubbed successful in achieving its chemical release and transport reduction goals in a timely and cost-effective manner. One such study, a paper by economists Seema Arora and Anthony Cason entitled, "An Experiment in Voluntary Environmental Regulation: Participation in EPA's 33/50 Program," thoroughly examines the firm-level characteristics that affect the probability with which a firm will join the Program. Their theory is based upon the notion that, if a firm's expected profit with participation in the Program ($E\prod_{i,P}$) is greater than the firm's expected profit without participation ($E\prod_{i,N}$), then the profit-maximizing firm will join the Program. Arora and Cason use a dummy variable D_i to denote firm i's participation decision: D_i will be equal to one if expected profits are greater with participation, and zero if expected profits are lower with participation. This is illustrated by the following expression:[18]

$$D_i = \begin{Bmatrix} 1 \text{ if } E\prod_i^P - E\prod_i^N + \varepsilon_i > 0 \\ 0 \text{ if } E\prod_i^P - E\prod_i^N + \varepsilon_i \leq 0 \end{Bmatrix}$$

Arora and Cason use a bivariate probit model to determine the likelihood with which a given polluter will voluntarily join the Program. Their righthand side variables are all factors presumed to affect firms' expected profits.

Arora and Cason assume that, first and foremost, differences in technologies and production processes across industries will change the benefits and costs of participation in the 33/50 Program or, in fact, any other voluntary program. Cleaner production technologies may not be available for certain industries, and the existence and character of manufacturers' associations may influence any individual firm's decision to participate. The amount of money any given industry tends to spend on research and development might affect participation rates within that industry, mostly because of the theory that technologically advanced firms are best positioned to profit from Program participation. The authors also mention that a firm's proximity to consumers will affect the decision to participate. These last two theories were discussed in Chapter One of this paper. Arora and Cason hypothesize that the market structure of a given industry will also affect participation: firms in more competitive industries would have greater incentive to differentiate their products than firms in less competitive industries, but firms in competitive industries would also have a more difficult time passing additional costs on to consumers. The authors expect participation rates to be lower in more competitive industries. They suggest that firms that use the greatest number of Program chemicals will have the most opportunities for mitigation, and will therefore have higher participation rates than firms which use fewer of the 17 Program chemicals. They do note, however, that firms with the largest ratios of chemical use to sales would, theoretically, have lower probability rates than firms for which the chemicals are not as intrinsic to the production process. Finally, they hypothesize that firms which are more profitable and healthier financially will be the most likely to participate in the Program, since these firms will not have the short-term tunnel vision of financially strapped companies (Arora & Cason: 1995).

Arora and Cason use EPA data from the 33/50 Program and the Toxic Release Inventory (TRI) to provide environmental data and to examine the chemical use of the seven industries with

the largest releases and transfers of the 17 chemicals covered under the Program. The seven industries are: chemicals (SIC 28), petroleum refining (SIC 29), rubber and plastics (SIC 30), primary metals (SIC 33), fabricated metals (SIC 34), electrical equipment (SIC 36) and transportation (SIC 37). The researchers use two other main sources of data: the EPA's Human Health and Ecotoxicity database (HHED), which is used to assign toxicities to the 17 different chemicals, and Standard & Poor's Compustat database, which supplies financial data on individual firms. The financial data they use is from 1990, the year before the Program began. Only 302 large, publicly traded firms "survived" the merging of the 33/50 Program, TRI and Compustat databases. They use a bivariate probit model, with the yes/no decision to participate in the Program as of February 1992, as given by the D_i dummy variable, being the lefthand side variable. Table I provides a list of the righthand side variables they used, each variable's symbol, the estimated sign and the significance given by Arora and Cason's model.

TABLE I: Arora and Cason's Firm-Level Model - Variables and Results

Variable	**Proxy**	**Symbol**	**Estimated Sign**	**Significance (yes/no)**
Employment	Firm Size	EMPLT	positive	yes
5-Year Average Return on Assets	A firm's profitability	PROFIT	positive	yes
Debt-to-Asset Ratio	A firm's financial structure and debt obligations	DTARATIO	negative	no
Herfindahl Index of Industry Concentration	Industry concentration/ competitiveness	HERF	negative	yes
Advertising Intensity	The proximity of a firm's products to the consumer	AD INT	negative	no
Research & Development Intensity	Technological ability of a firm to participate in the Program	RD INT	positive	no
Total Releases, Weighted by Toxicity	Aggregate toxicity level of the chemicals used by a firm; captures potential gains from Program participation	WTREL	positive	yes
Intensity of Chemical Use	Importance of Program chemicals to a firm's production; Ability of a firm to participate in the Program	REL INT	negative	no
Number of Categories of Program Chemicals Used	Captures potential gains from Program participation	NOCAT	positive	yes

Arora and Cason's results imply that there are several firm- and industry-level characteristics that affect the likelihood that an individual company will participate in the 33/50 Program. Their model does not, however, address how the costs and benefits of participation might be affected by threats of mandatory regulation. The authors state that the paper's purpose is to, "assess the potential ability of voluntary programs to augment more contentious command and control regulation," but they do not measure the effect(s) that the threat of such regulation might have on a firm's decision to participate. By omitting variables relating to legislative threats, Arora and Cason may have left out several significant categories of benefits and costs of Program participation - namely, future competitive advantage, first-mover advantage, recognition under future regulation and overseas industry pressure. The empirical model that appears in Chapter Three is an attempt to remedy their omissions and measure the effects that governmental and other public bargaining powers may have on a firm's weighing of the costs and benefits of Program participation and, therefore, the firm's participation decision.

Chapter Three

The Empirical Model

Introduction

The empirical portion of this paper uses an ordinary least squares regression to test 11 variables for their potential effects on state-level participation in the 33/50 Program. The dependent variable is the cumulative participation rate of the facilities invited to join the Program in each state, and is denoted PR_S. Participation is measured as the number of facilities in each state that participated in the Program over the number of facilities that the EPA invited to join, and is the program-end, cumulative participation rate. The lowest participation rate (13.3 percent) belongs to Rhode Island, and the highest participation rate (51.9 percent) belongs to Delaware. The mean participation rate (31.3 percent) is closest to that of Connecticut (31.4 percent), Arizona (31.1 percent), Arkansas (31.5 percent), Florida (30.8 percent) and Alabama (30.5 percent). The standard deviation of the participation rates is roughly .068814; the complete table of descriptive statistics appears in Table II on page 33. This five-state sampling, and the states with the minimum and maximum participation rates, suggest no pattern of participation that is strictly geographical. Data used to compute the participation rates come from "33/50 Program: The Final Record," a summary document published by the EPA in March of 1999.

The right-hand side variables represent 11 aggregate political and economic characteristics of the 48 continental states; the District of Columbia, Alaska and Hawaii, while they had facilities participating in the Program, have to be excluded from the regression analysis because of missing data. The first five variables in the model below, $ASNC_S$, AVR_S, LCV_S, SCM_S and $PDUM_S$, are all proxied indicators of the level of "public bargaining power" that is present in a state, as Kathleen Segerson and Thomas J. Miceli would put it. The next two variables, PME_S and $PSIC_S$, proxy the level of political bargaining power held by manufacturing industries within a state, i.e., the political clout or bargaining power of the industries most susceptible to regulation of toxic chemical use. The remaining variables, $IMEC_S$, $SIZE_S$, UR_S and $CEVS_S$, measure relative economic characteristics of the states and, in particular, manufacturing industries. The subsequent paragraphs define each variable and proceed to explain how the data for each were gathered and what, if any, manipulations

were done. The results of the regression and tests are in Chapter Four.

The Model:

$$PR_s = \beta_0 + \beta_1 ASNC_s + \beta_2 AVR_s + \beta_3 LCV_s + \beta_4 SCM_s + \beta_5 PDUM_s + \beta_6 PME_s + \beta_7 PSIC_s + \beta_8 IMEC_s + \beta_9 SIZE_s + \beta_{10} UR_s + \beta_{11} CEVS_s + \varepsilon_s$$

Where $PDUM_S$ is a dummy variable such that:

$$PDUM_s = \begin{cases} 1 \text{ if the plurality of survey respondents identifies with the Democratic party} \\ 0 \text{ if the plurality of survey respondents does not identify with the Democratic party} \end{cases}$$

s = state in the continental United States

Descriptions of the Variables

The variable $ASNC_S$ is a proxy for the threat of enforcement of hazardous waste regulations in each state for the years 1991 - 1995. The variable represents the number of Addressed Significant Non-Compliances (SNCs) of three EPA hazardous waste regulations: the Emergency Protection and Community Right-to-Know Act (EPCRA), the Toxic Substances Control Act (TSCA) and the Resource Conservation and Recovery Act (RCRA).[19] "Addressed SNCs" is a percentage of the number of SNCs addressed by the EPA in a state over the total number of SNCs reported in that state for the three EPA programs. The EPCRA, RCRA and TSCA programs regulate the reporting of toxic chemical use, the disposal of solid and hazardous wastes and the use of certain chemicals and other controlled substances, respectively.[20] These programs are all similar to the 33/50 Program in that they govern the use and disposal of toxic chemicals and hazardous wastes, and the 33/50 Program was designed to reduce the releases and transfers of these same chemicals. The EPA enforcement database used to compute these data gives the total number of

SNCs, the number of addressed SNCs, and the percentage of addressed/total SNCs for each year in which there were SNCs for each of the three programs. The variable $ASNC_S$ closely proxies the level of *mandatory* toxic use and release regulatory threat that the facilities invited to join the 33/50 Program would have felt when making their participation decisions. The numbers used in the empirical model are the total average percentages of addressed SNCs over the period 1991 - 1995. It is expected that the coefficient on $ASNC_S$ will be positive, since firms would feel a stronger threat of mandatory regulation if the EPA in a given state operates in a thorough and strict manner when dealing with noncompliance. A regulatory body would be seen as less threatening, and less likely to enforce new mandatory legislation, if it cannot even address violations of existing laws. Descriptive statistics for $ASNC_S$ are in Table II.

The variable AVR_S is a proxy for the political participation rates and overall political/ civic engagement of the voting-age population of each state. This proxy is the average presidential voting rate in each state, calculated as the average of the voting rates in the 1988, 1992 and 1996 presidential elections.[21] It is hard to predict the sign that the coefficient on AVR_S might have, because the political awareness of registered voters could have either a positive or negative effect on the level of threat of impending regulation felt by a firm. Depending on the interests of voters, high values for AVR_S could signal bargaining power on the (public) side of the regulatory body or on the side of the manufacturing industry. If voters are extremely concerned with environmental issues, then high values of AVR_S should increase the bargaining power of the public regulatory body, thereby increasing the threat of legislation and prompting more firms to join the 33/50 Program. On the other hand, if there is little concern for environmental issues, and particularly if a significant portion of the state's economy and, therefore, political interests, is made up of manufacturing, then the coefficient on AVR_S would probably be negative, since firms would feel less pressure from local communities to reduce chemical use. The effect of voting rates on the model will, therefore, probably be mixed. Descriptive statistics for AVR_S appear in Table II.

The level of awareness and attentiveness that a state's Congressional delegation has toward environmental issues, and, to a lesser degree, the way in which Members of the U.S. House and Senate perceive the concerns of their constituents, is proxied by the LCV_S variable. These values

are the pro-environmental health and safety voting ratings given to each member of Congress by the League of Conservation Voters (LCV), an environmental watchdog and lobbying group based in Washington, D.C., for the years 1989 through 1995. Each year the LCV determines which legislative bills are pro-environment and which bills are anti-environment, and then tallies how each Member of Congress voted on those bills. The higher the LCV rating, expressed as a percent, the more pro-environment the representative or senator.[22] The data that enter into the regression are the aggregate, average scores for each state's delegation between 1989 and 1998. The scores, given as a percentage, for each state's Senators and Representatives were added together for each of the years 1989 through 1995 and divided by two to get an overall score for the state for each year. In essence, the LCV_S variable is another proxy for the state-level threat of environmental regulation and/ or stringency, manifested in the decisions made by elected officials. The sign on the coefficient of LCV_S is expected to be positive: the firms invited to participate in the 33/50 Program might have felt higher levels of regulatory threat in states where the elected national representatives were pro-environment than in states where the elected representatives voted against the interests of environmental health and safety. According to the theories used to form this model, this perceived higher likelihood of impending anti-pollution legislation should raise the benefits of participation to the firm, and therefore increase the voluntary participation rate. Descriptive statistics for LCV_S appear in Table II.

Another variable that proxies citizens' bargaining power in environmental regulatory decision making is SCM_S, annual Sierra Club membership measured as the number of Sierra Club Members in a state in each year 1990 -1995, divided by the total population of that state in each year. Sierra Club membership information was provided by the Sierra Club, and state population data were obtained from population forecasts conducted by the U.S. Census Bureau.[23] Whereas the average voting rate is only a proxy for citizens' political and social engagement, membership in the Sierra Club, one of the nation's first environmental interest groups, indicates proactive political engagement and, more specifically, concern with environmental issues. It was explained in Chapter One of this paper that stakeholders' environmental concerns can have significant effects on a firm's decision to participate in a voluntary environmental program, particularly if the firm's emissions are publicized, as they are for most of the firms invited to join the EPA's 33/50 Program.

Therefore, it is expected that the more Sierra Club members there are as a percentage of total state population, the higher the environmental community's bargaining power will be and, therefore, the higher Program participation rates will be. The sign on the coefficient of SCM_S is expected to be positive. Descriptive statistics for SCM_S appear in Table II.

The only qualitative dummy variable in this model is $PDUM_S$, which gives a rough picture of the state's political leanings. The variable $PDUM_S$ is entered into the equation as a one if the plurality of a state's residents consider themselves Democrats (as opposed to Republicans or Independents).[24] The LCV annual Scorecard rates Members of the U.S. Congress on environmental issues, with the higher scores going to those Members who cast the most votes in favor of environmental health and safety. The Scorecards produced immediately prior to and during the duration of the 33/50 Program, as well as every Scorecard since then, give Democratic Members much higher ratings than Republican Members.[25] The sign on the coefficient of $PDUM_S$ is expected to be positive, since firms in Democratic-leaning states should, theoretically, feel pressure to have better environmental records, assuming those Democrats support environmental initiatives with the same consistency as do the men and women they elect to Congress.

The percentage of each state's total employment that is made up by employment in manufacturing is contained in the variable PME_S. This variable proxies the economic importance of manufacturing to the residents of the state, and, therefore, part of the bargaining power of manufacturing industries. Polluting industries that make up a significant portion of a state's economy and wage base should, theoretically, have a proportionate say in the decisions affecting their businesses. If state manufacturing industries do not want environmental regulation, then a large value for PME_S will suppress participation in the 33/50 Program and, presumably, other environmental health and safety programs. On the other hand, a progressive state, or a state with manufacturing companies that see profit in clean production, might actually find that a big manufacturing sector will promote participation in environmental programs. In other words, the sign that this variable is expected to have is uncertain, but it is most likely to be negative. The PME_S values are the product of employment in manufacturing over total employment for each state,

as given by the 1990 Census.[26] Descriptive statistics for PME_S appear in Table II.

The 33/50 Program concentrated much of its recruiting energy on the 600 companies with the most releases and transfers of the relevant chemicals; these were the first companies asked to join the Program.[27] Arora and Cason look at data from companies with SIC codes from the industries that have, according to their 1995 paper, the largest releases and transfers of 33/50 chemicals.[28] Those industries are: chemicals (SIC 28), petroleum refining (SIC 29), rubber and plastics (SIC 30), primary metals (SIC 33), fabricated metals (SIC 34), electrical equipment (SIC 36) and transportation (SIC 37). Since both very dirty and very clean industries fall under the general category of manufacturing, including an estimate of the relative "dirtiness" of the manufacturing sector in each state should be a proxy for the anti-regulation industrial lobbying power. To estimate the composition of a state's manufacturing industry, the variable $PSIC_S$ is included in this model. $PSIC_S$ gives the percentage of manufacturing facilities within each state that have one of the seven SIC codes listed above. The values are calculated with data from the 1995 Annual Survey of Manufactures (ASM) Geographic Area Statistics report, and represent the number of facilities within industries with SIC codes of 28, 29, 30, 33, 34, 36 and 37 in each state divided by the total number of manufacturing facilities in each state, averaged over the years 1989 - 1995.[29] In terms of bargaining power, there is strength in numbers, and so the greater the percentage of a state's manufacturing industry that is made up of these seven dirty industries, the more bargaining power these industries could have in preventing the imposition of mandatory pollution control legislation. Recall that, according to the hypothesis, the higher the industrial bargaining power is relative to that of the regulator, the lower firms will perceive the potential benefits of voluntary participation to be. On the other hand, a large group of heavy polluters might make companies in a state with a high value for $PSIC_S$ targets for citizen and environmental activist groups; this would tilt bargaining power in favor of the public. To complicate things further, though, a state with a high value for $PSIC_S$ suggests relatively high employment in these industries: and the (voting) public in such a state might therefore not consider environmental health and safety to be top concerns when compared to their livelihoods, if that is how they see the matter. If this is the case, then political bargaining power swings back to industry. Overall, given the mix of

possible influences that dirty industries might have on the balance of regulatory/ industrial bargaining power within a state, the sign on the coefficient of the $PSIC_S$ variable is still expected to be negative, since it is a proxy for the bargaining power of industry. Descriptive statistics for $PSIC_S$ appear in Table II.

The $IMEC_S$ variable gives values for the change in the index of state manufacturing employment between 1989 and 1995, and indicates the growth of manufacturing employment in a state over the course of the Program. The data used for this variable come from the 1995 ASM Geographic Area Statistics report, which uses 1987 as the baseline year and enters numbers less than 100 to indicate a drop in manufacturing employment compared with the baseline year, and number over 100 to indicate a rise in manufacturing employment in each year. The index numbers for each year 1989 through 1995 are averaged to get an overall number that indicates whether manufacturing employment rose or fell during the course of the 33/50 Program. The mean index number for 199 observations is about 104, and the median is 103, signaling an overall increase in manufacturing during the years the Program was in operation. The other descriptive statistics for $IMEC_S$ can be seen in Table II. The effect of manufacturing growth over the course of the program could have both negative and positive effects on the program. First, a growing manufacturing sector could give existing manufacturing firms, i.e., the ones that were asked to join the 33/50 Program, more bargaining power versus the public regulatory body and, therefore, less of an incentive to join the voluntary Program. Moreover, a growing manufacturing sector could, but does not necessarily, suggest that a state with a high value for $IMEC_S$ has relatively lax enforcement of environmental policies, or offers other incentives to attract manufacturers. There is the possibility, though, that new manufacturing facilities would operate "cleaner" than existing manufacturing facilities, because the capital equipment will be new for those firms. If this is in fact the case, and the $IMEC_S$ value is greater than 100, i.e., the manufacturing sector is growing, then older and dirtier facilities might feel local industry pressure to voluntarily reduce chemical releases and join the the 33/50 Program. Overall, though, the coefficient on the $IMEC_S$ variable is expected to be negative, since the theory of increased bargaining power for companies within a growing industry or sector seems as though it would have a greater impact on participation rates than the less direct internal "shaming" theory of industry.

Much of the theoretical literature suggests that larger firms are more likely than smaller ones to engage in voluntary environmental protection. Seema Arora and Timothy Cason's empirical study of 33/50 Program participation concludes that firm size has a positive and significant impact on participation, i.e., larger firms were significantly more likely to join the Program (Arora & Cason: 1995). Robert Baylis, Lianne Connell and Andrew Flynn write in their article, "Company Size, Environmental Regulation and Ecological Modernization: Further Analysis at the Level of the Firm," that, "the opportunities and abilities to manage environmental impacts better are likely to be skewed towards larger firms" (Baylis *et. al.*: 1998, 286). Of the companies these researchers survey, 63 percent of the large companies have environmental policies,while only 17 percent of small-to-medium companies surveyed have environmental policies. In the paper written by Baylis *et. al.* and in others, company size is linked to other motivations for participation, such as increased public visibility for larger firms, for example. Particularly in the case where a facility publicly reports pollution, larger firms with larger volumes of chemical releases tend to be targeted by stakeholders for improved environmental policies and practices, and may also be the best equipped to eliminate significant amounts of pollution from their processes (Baylis *et. al.*: 1998; Arora & Cason: 1995; Wapner: 1998). Moreover, large companies might experience greater flexibility in achieving ambitious voluntary standards. For example, it is unlikely that BP could have had such a successful and efficient internal GHG emissions trading program if it hadn't been such a large, geographically dispersed corporation.[30] The $SIZE_S$ variable in this model gives the average size of a manufacturing facility in a state, measured as total manufacturing employment over the total number of manufacturing facilities in each state, averaged over the years 1989 - 1995.[31] It should be noted that the average size of a facility asked to join to 33/50 Program and the overall average size of a manufacturing facility might differ, because the EPA targeted the facilities that had the largest chemical releases and transfers, i.e., mostly the biggest facilities. While the $SIZE_S$ variable is therefore not as accurate as desired, it still paints an overall picture of the size of manufacturers in each state, and, possibly, the likelihood that facilities were asked to join the Program and did join. It is expected that the sign on the coefficient of $SIZE_S$ will be positive, since, in keeping with the theoretical discussion above, bigger facilities see greater pressure to adopt environmental protection programs than smaller companies, and the benefits of participation - and

the costs of non-participation - might therefore be greater for large firms than for small. The descriptive statistics for $SIZE_S$ appear in Table II.

The statewide unemployment rate, denoted UR_S in this model, is an indicator of general economic health in a state, and may also be an indicator of the degree to which workers, including unemployed workers, put political emphasis on environmental health and safety issues. It is a common belief that there exists a tradeoff between jobs and the environment, particularly among industries that are heavily monitored for environmental infractions, like the logging and manufacturing industries. Therefore, it may be that states with high unemployment rates have lower Program participation rates than other states, because there could be less pressure coming from citizens to mitigate environmental hazards than there is to create new jobs - the bargaining power of the public, in the presence of high unemployment, might favor a moratorium on new environmentally related laws or even a rollback of existing laws. On the other hand, there is a more direct link between unemployment rates and participation rates in the other direction: a high unemployment rate means that a state's economy has slowed, and that manufacturing production might have slowed as well. If a facility sees benefits to participating in the 33/50 Program, and if that facility is not operating at full capacity - full employment - anyway, then the facility may be able to claim pollution "reductions" without changing anything about their manufacturing processes except that amount of the good that is produced. Avoiding capital and other costs typically associated with corporate environmental efforts make it more likely that a firm will see the benefits of participation as outweighing the costs, and will therefore be more likely to join the Program. In other words, unemployment may promote participation in the Program because it makes participation easier: rather than operating at full capacity and changing its production processes, a facility can simply cut production and reduce emissions that way. The total 16-and-over unemployment rate in each state is tallied for each year 1989 - 1995, and then averaged to get an average unemployment rate for each state during the planning and implementation parts of the 33/50 Program.[32] Since the link between unemployment and the reduced operation of manufacturing facilities is more direct than the link between unemployment, citizen preferences and potential policy threats, it is expected that the sign on the coefficient of UR_S will be positive. Data for the UR_S variable come from the U.S. Department of Labor Bureau of Labor Statistics.

Descriptive statistics for UR_S are available in Table II.

The final variable in this model, $CEVS_S$, is an average of the rate of new manufacturing capital expenditures over the value of manufacturing shipments for each year 1989 - 1995.[33] The larger the value is for this rate, the more expansive is a state's manufacturing economy. Thus, this variable proxies manufacturing growth and development within a state. Whereas the unemployment rate is a rather pessimistic way to view participation in the Program, the rate of capital expenditures over the value of shipments indicates how an expanding economy can also be good for the environment. If the new capital being purchased is replacing older, dirtier capital equipment, then these expenditures proxy a baseline "greening" of industry. Similarly, if new capital is being bought to build new factories, business owners might take the operating efficiency of the equipment into account before making the purchase, either assuming that their facilities will be subject to increasingly strict environmental regulations, or because it makes sense in terms of operating efficiency. Thus, it is expected that the sign on the coefficient of $CEVS_S$ will be positive. Descriptive statistics for $CEVS_S$ appear in Table II.

TABLE II: Descriptive Statistics

	PR	ASNC	AVR	LCV	SCM	PDUM
Mean	0.312573	0.534948	0.604257	0.982202	0.001601	0.39583
Median	0.316349	0.549242	0.6105	0.975714	0.001438	0
Maximum	0.519231	0.792089	0.700333	1.828571	0.005006	1
Minimum	0.133333	0.182578	0.509333	0.105714	0.000356	0
Std. Dev.	0.068814	0.143267	0.054594	0.406115	0.001019	0.49420
Skewness	0.065412	-0.562096	-0.11614	0.137275	1.61505	0.42601
Kurtosis	4.495537	3.079706	2.009722	2.414416	5.94072	1.18149
Jarque-Bera	4.507492	2.540321	2.069207	0.836573	38.16275	8.06588
Probability	0.105005	0.280787	0.355367	0.658174	0	0.01772
Sum	15.00349	25.67752	29.00433	47.14571	0.076844	19
Sum Sq. Dev.	0.222561	0.964697	0.140085	7.751686	4.88E-05	11.4792
Observations	48	48	48	48	48	48

	PME	PSIC	IMEC	SIZE	UR	CEVS
Mean	0.16879	0.056973	103.7708	46.72202	0.057994	0.03527
Median	0.171888	0.056798	102.75	44.47413	0.058571	0.03302
Maximum	0.266912	0.098333	138.75	90.50204	0.095286	0.06657
Minimum	0.059422	0.029991	77.25	15.57093	0.027571	0.02119
Std. Dev.	0.05494	0.013825	14.89902	15.24652	0.011738	0.00843
Skewness	-0.206562	0.439579	0.303183	0.268759	0.169365	1.31566
Kurtosis	2.296651	3.413832	2.79782	3.299354	4.260633	5.67685
Jarque-Bera	1.330741	1.88835	0.817115	0.757076	3.407867	28.1789
Probability	0.514083	0.389	0.664608	0.684862	0.181966	0
Sum	8.101902	2.734689	4981	2242.657	2.783714	1.69295
Sum Sq. Dev.	0.141865	0.008983	10433.1	10925.45	0.006475	0.00334
Observations	48	48	48	48	48	48

Chapter Four

Empirical Results and Analysis

Data

The ordinary least squares regression presented in Chapter Three yields a number of significant variables, and the signs on almost all coefficients are as predicted by the theoretical considerations. The model is rewritten for reference, and the summary statistics for the regression appear below. Table III provides the critical values needed to conduct tests for statistical significance.

$$PR_s = \beta_0 + \beta_1 ASNC_s + \beta_2 AVR_s + \beta_3 LCV_s + \beta_4 SCM_s + \beta_5 PDUM_s + \beta_6 PME_s + \beta_7 PSIC_s + \beta_8 IMEC_s + \beta_9 SIZE_s + \beta_{10} UR_s + \beta_{11} CEVS_s + \varepsilon_s$$

Among other things, the original regression analysis shows that the $PDUM_S$ variable has a very small t-statistic, and is nowhere near significant at the 5% level. In order to find out if $PDUM_S$ can be dropped from the model without significantly affecting it, an unrestricted model (the original model with 11 right-hand side variables) and a restricted model (one without $PDUM_S$ in it) must be compared. Removing $PDUM_S$ from the model might improve the fit of the model because the dummy variable for political identification could be positively correlated with LCV_S, given that, according to the League of Conservation Voters Scorecards, Democrats are far more likely than Republicans to support environmental health and safety protection in Congress. It might also be positively correlated with SCM_S, because, like the politicians they elect, Democratic voters tend to be more supportive of environmental protection and public health and equity causes than Republican voters. It's worth seeing whether or not the variable can be improved without hurting the fit of the model, and possibly improving it. The equation for the restricted model and its summary statistics are also given below.

Restricted Model[a]*:*

$$PR_s = \beta_0 + \beta_1 ASNC_s + \beta_2 AVR_s + \beta_3 LCV_s + \beta_4 SCM_s + \beta_6 PME_s + \beta_7 PSIC_s + \beta_8 IMEC_s + \beta_9 SIZE_s + \beta_{10} UR_s + \beta_{11} CEVS_s + \varepsilon_s$$

Summary Statistics

	Original Model	Restricted Model
$ASNC_S$	-0.124184**	-0.111592**
	(0.05251)	(0.049984)
AVR_S	0.221123	0.269495*
	(0.1667757)	(0.156315)
LCV_S	-0.065883*	-0.057292**
	(0.025543)	(0.023185)
SCM_S	17.14495	19.03269*
	(10.37398)	(10.06954)
$PDUM_S$	0.016764	----------
	(0.02047)	----------
PME_S	-0.584379***	-0.626327***
	(0.211385)	(0.20417)
$PSIC_S$	-2.093138***	-2.098319***
	(0.601088)	(0.598374)
$IMEC_S$	-0.000939	-0.000881
	(0.000777)	(0.00077)
$SIZE_S$	0.004934***	0.005205***
	(0.00091)	(0.000844)
UR_S	2.447438**	2.905887***
	(1.022334)	(0.851634)
$CEVS_S$	1.873435*	1.686566
	(1.09601)	(1.067213)

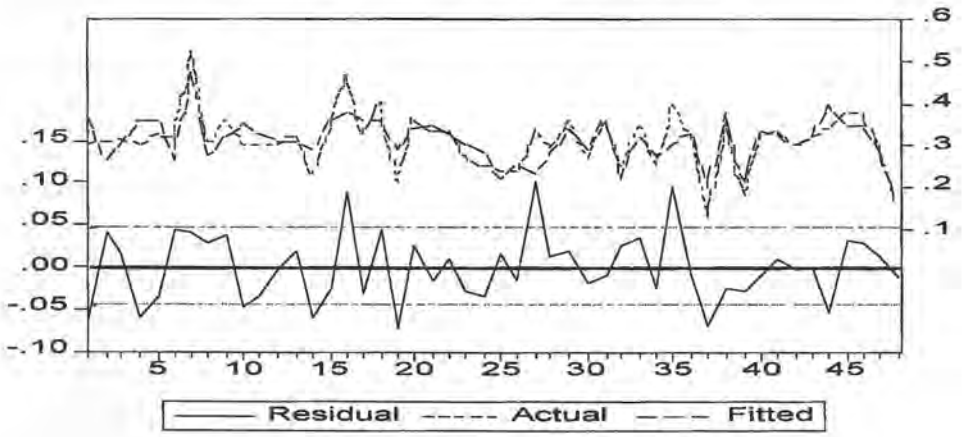
* = significant at the 10% level
** = significant at the 5% level
*** = significant at the 1% level

The results of an F-test (estimated F = .689 < 4.08) indicate that $PDUM_S$ can be dropped from the model without reducing the fit of the regression. The adjusted R-squared is actually one one-thousandth larger in the restricted model than in the unrestricted model. This difference is small, but nonetheless important to note, as it shows that the fit of the model is improved by the

omission of $PDUM_S$. Removal of $PDUM_S$ has the expected positive effects on the potentially correlated variables LCV_S and SCM_S: the coefficient of LCV_S becomes less negative, and the coefficient of SCM_S gets larger.

The residual plot of the restricted model's regression shows several states whose participation rates are over- or under-estimated by the regression. Louisiana, New Hampshire and Oregon all have much higher Program participation rates than the model would suggest, and Alabama, California, Kansas, Massachusetts, Rhode Island and Virginia all have much lower participation rates than the model's regression would give. These states range from being the largest in the nation (California) to the smallest (Rhode Island) in terms of land area, and the other states are representative of moderately sized states. Rhode Island has the lowest participation rate (13.3 percent) and Louisiana has the second-to-highest (47 percent). The rest of the standout states have participation rates much closer to the mean. This model, then, does not bias any one region of the United States, but it may provide inaccurate results for some states.

Residual Plot for the Restricted Model



It is worthwhile testing the variables that are not presumed to be related to public or private bargaining power - $IMEC_S$, $SIZE_S$, UR_S and CEV_S - for joint significance. According to the restricted model, $SIZE_S$ and UR_S have significant and positive effects on participation rates at the 5 percent level of significance; these outcomes are in line with what the theoretical argument predicts. The variables $IMEC_S$ and CEV_S, though, are not significant to the model, although the signs on their coefficients turn out to be as the theory predicts, too. In order to test for joint significance, the fit of a new restricted model can be compared to the fit of the "old" restricted model, the model with all variables except $PDUM_S$:[35]

Restricted Model:

$$PR_s = \beta_0 + \beta_1 ASNC_s + \beta_2 AVR_s + \beta_3 LCV_s + \beta_4 SCM_s + \beta_6 PME_s + \beta_7 PSIC_s + \varepsilon_s$$

Summary Statistics

	Restricted Model
$ASNC_S$	-0.107177
	(0.071319)
AVR_S	-0.229329
	(0.180522)
LCV_S	-0.021141
	(0.027518)
SCM_S	6.325905
	(10.81921)
PME_S	0.356142*
	(0.186846)
$PSIC_S$	-1.248993*
	(0.730752)

* = significant at the 10% level

F-test:

$H_o: \beta_8 = \beta_9 = \beta_{10} = \beta_{11} = 0$

H_a: One or more of the equalities above is false: the four variables are jointly significant.

$$\hat{F} = \frac{(.180821 - .077957)/(10-6)}{.077957/(48-10)} = 12.535$$

$F^{CV}_{4,38} \approx 2.61$ at the 5% level of significance

$\hat{F} > F^{CV}_{4,38} \Rightarrow$ Reject H_o at the 5% level of significance: $IMEC_s, SIZE_s, UR_s$ and $CEVS_s$ are jointly significant to the model.

Table IV compares the expected sign of each of the coefficients to the sign that appears on the estimated coefficient for each variable. All but two of the predictions based on theory and previous empirical evidence are consistent with the results of the regression. It is interesting, however, that the two variables that have unexpected effects on the model are the two variables intended to proxy the bargaining power of the regulatory body ($ASNC_S$) and the federal government (LCV_S). Comparing the absolute values of each coefficient's t-statistic to the t-critical value presented in Table III, it is also evident that the coefficients of both of these variables are strongly significant at the 5% level. It is expected in any econometric work that some of the independent variables will not prove to be significant, and this expectation is again proven to be the case in this model. However, the fact that two highly significant variables have the opposite-of-expected effect on Program participation rates indicates that the theoretical arguments used to justify the inclusion of these variables, and the model itself, must be reconsidered.

TABLE III: Information for Statistical Tests

degrees of freedom:	48 - 10 = 38
two-sided test, critical value at 5% LOS:	2.024
two-sided test, critical value at 10% LOS:	1.686

TABLE IV: Expected vs. Estimated Signs

Variable	t-statistic	Expected Sign	Estimated Sign
ASNCs	-2.232548	+	–
AVRs	1.724054	+/ —	+
LCVs	-2.471086	+	–
SCMs	1.890126	+	+
PMEs	-3.067667	–	–
PSICs	-3.506704	–	–
IMECs	-1.143896	–	–
SIZEs	6.165823	+	+
URs	3.41213	+	+
CEVSs	1.580346	+	+

Analysis

As far as the direction of the effect on 33/50 Program participation rates that each variable was predicted to take, most of the independent variables performed as expected in the regression. The coefficients of four variables - PME_S, $PSIC_S$, $SIZE_S$ and UR_S - turn out to be significant at the 5% level, and their coefficients have the appropriate signs as determined by the theories outlined in Chapter Two and Chapter Three. It appears that the size of manufacturing's share of state employment, and the share of manufacturing employment held by the seven most polluting industries, both have negative effects on participation rates. This supports the bargaining power theory posited by Segerson and Miceli as applied to the case of the 33/50 Program. After scaling the coefficients to account for differences in the magnitude of the numbers by multiplying the coefficient on PME_S, one can see that a unit change in the percentage of total employment made up of manufacturing employment has a bigger per-unit effect on participation rates that the percent of manufacturing employment made up of the seven dirtiest industries.[36]

Two variables, $SIZE_S$ and UR_S, both have positive and significant impacts on participant rates at the 5% level. These results are consistent with the economic literature: bigger firms, or more precisely states with larger average manufacturing facility sizes, are often found to be significantly more likely to voluntarily reduce their harmful environmental impacts in theoretical and empirical models. And, rather than discouraging the adoption of environmental initiatives in manufacturing, high unemployment rates contribute to high Program participation rates. Scaling the coefficients by dividing the coefficient on UR_S by 1,000 reveals that, other factors held constant, average firm size has a larger impact on participation rates than the unemployment rate does.

The variable representing the rate of membership in the Sierra Club, SCM_S, has a t-statistic of approximately 1.89, which makes the variable significant at the 10% level. The coefficient of SCM_S has the sign predicted by the theoretical argument: citizens' environmental vigilance is a significant motivator for firms. Given the body of theoretical and empirical work which emphasizes the importance of community goodwill, and the potential power of local activists proxied by SCM_S, it's somewhat surprising that the SCM_S variable is not more strongly significant. Perhaps other

proxies for private environmental vigilance would yield different results. It would be interesting to differentiate among the various forms of civic activism and to empirically determine which forms of activism are the most effective. That is a topic for a different paper, though. The coefficient on SCM_S appears to be very large in the regression output, indicating very large changes in participation rates for corresponding unit changes in the value of SCM_S, but this is, again, a result of the fact that the data, measured as Sierra Club membership over state population, have very small values. If the coefficient is scaled to that of AVR_S, another proxy for political attentiveness, the coefficient on SCM_S would actually have a coefficient of just .1903.

Three other variables, AVR_S, CEV_S and $IMEC_S$, prove to be insignificant to the model, but nonetheless have the signs predicted by the aforementioned theoretical arguments. The most intriguing outcomes of the regression are certainly those pertaining to the proxies for the bargaining power of the regulatory body and the legislative body of government, $ASNC_S$ and LCV_S. These results will be discussed in turn.

The $ASNC_S$ variable was described in Chapter Two as a proxy for the level of mandatory regulatory threat that the facilities invited to join the 33/50 Program would have felt when making their participation decisions, as it represents the average number of addressed episodes of significant non-compliance with existing toxic chemical regulations. The theoretical model of the relative bargaining powers of a regulatory body and an industry put forth by Segerson and Miceli concludes that voluntary participation in an environmental program will become more likely as the bargaining power of the regulatory body increases, and less likely as it decreases in relation to a firm's bargaining power. By this logic, the higher the average level of addressed significant non-compliance with existing regulation was in a state, the higher the participation rate of firms in that state should have been. The empirical evidence gives the opposite conclusion, though: the stricter the enforcement of EPA toxics regulations in a state, the *less* likely were firms to participate in the Program.

One possible explanation for this outcome is that enforcement could be correlated with some understood agreement between the EPA and firms whereby the EPA agrees to cut firms some regulatory slack in return for the firms agreeing to join the 33/50 Program. If this were the case, then participation rates would increase as enforcement decreases, as they do in the model's

regression. Arora and Cason considered this possibility of preferential treatment for voluntarily participating firms, and compared the list of participating Program companies to the list of companies that had been penalized under the Toxic Substances and Control Act (TSCA). They find that eight out of 23 (35 percent) of the companies penalized under TSCA were enrolled in the 33/50 Program, and that the firm with the largest TSCA fine ($17 million), Chevron, was a full participant in the Program. They mention another Program participant that was cited $4.8 million in TSCA fines. Arora and Cason conclude that Program participation does not, in fact, free a company from regulatory obligations (Arora & Cason: 1995, 273).

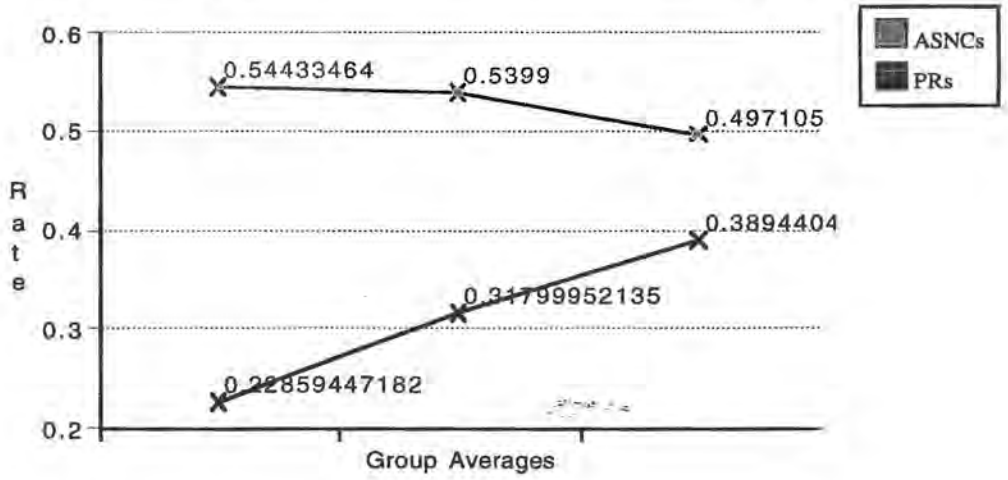
Arora and Cason's anecdotal evidence seems to disprove the hypothesis that firms and the EPA trade participation in the 33/50 Program for less stringent enforcement of mandatory environmental health and safety legislation. Alternative models of enforcement and compliance, however, present strong theoretical evidence that a regulatory body may "make a deal" with a polluter in one context to increase the aggregate level of compliance over a variety of environmental programs and polluters (Heyes & Rickman: 1998; Amacher & Malik: 1996). Economists Anthony Heyes and Neil Rickman propose a theoretical model in which the regulator is tolerant of noncompliance at some times and with some firms in order to bring about higher levels of compliance at other times and with other regulated firms (Heyes & Rickman: 1998). Their theory is an attempt to explain why firms are compliant with regulation a significant portion of the time even though the EPA rarely pursues violators and the expected penalty for noncompliance is usually less costly than the equipment needed to actually achieve compliance. They theoretically test the hypothesis that the EPA uses a strategy of selective penalizing to maximize aggregate, steady-state compliance over firms in a number of enforcement areas, i.e., over a set of laws regulating the use and disposal of different types of pollution over a variety of media (air, groundwater, etc.). Heyes and Rickman conclude that "regulatory dealing," as they call it, can in fact, "buy" the compliance of a large portion of the regulated population by penalizing a select few companies in a subset of regulatory spheres (Heyes & Rickman: 1998, 373).

Their results suggest that the EPA's failure to address a large percentage of regulatory violations in some states may not be evidence of *lax* enforcement, but rather evidence of *strategic* enforcement. This possibility calls into question the validity of Segerson and Miceli's bargaining power theory, since one could infer from Heyes and Rickman's conclusion that the the EPA

actually *conserves* its bargaining power through strategic, selective penalization rather than flex all of its regulatory muscle at once. This could explain why higher rates of $ASNC_S$ are shown to reduce participation in the 33/50 Program. The EPA enforcement activities in those states may not have been coordinated enough to utilize a system of "strategic tolerance of non-compliance," a situation which, if Heyes and Rickman's model translates to reality, would have reduced overall compliance (including voluntary compliance, perhaps) with toxics regulation among industries (Heyes & Rickman: 1998, 366).

If the EPA does in fact derive its ability to threaten firms from its ability to selectively pursue non-compliance, then its ability to have sway over companies diminishes every time an enforcement action takes place. Evidence in support of this hypothesis can be found in Figure One below, which illustrates the statistical relationship between the EPA's level of enforcement of existing toxic regulations ($ASNC_S$) and Program participation rates. The data used in the chart come from ordering the 51 observations for $ASNC_S$ and PR_S in ascending order of participation rates, and then dividing the observations into three groups of 17. The average $ASNC_S$ and PR_S for the each section are the six points that make up the two lines; each group average appears next to the appropriate point in Figure One. While the relationship is not perfectly linear, there is a consistent inverse relationship between $ASNC_S$ and PR_S.

Figure One: Potential Loss of EPA Bargaining Power



This trend can also be seen, although not as clearly, in Figure Three. There is no way of knowing, given the data available, whether lower rates of addressed SNCs occur because of strategic bargaining or because of, for example, tight budgets that do not allow for much pursuit of violators. If SNCs were not addressed because of budget problems, though, firms may not have perceived the same threat level as if SNCs remained unaddressed because the EPA was conserving its bargaining power. If it can be assumed that lower values for $ASNC_S$ occur when the EPA operation in that state is conserving its bargaining power to engage in strategic bargaining, then the empirical results could have some interesting interpretations. If the assumption holds, then the relationship between EPA enforcement rates and 33/50 Program participation rates provides some empirical evidence for the theoretical hypothesis that cooperative, strategic regulatory bargaining yields higher voluntary participation rates in environmental programs than simply strict enforcement. This is an area of study that deserves more empirical testing.

This bargaining game suggests that cooperative game theory could be used to explain or at least investigate the EPA's enforcement strategies. Gregory S. Amacher and Arun S. Malik do, in fact, present a theoretical model in which the environmental regulatory body and the regulated firm employ a Nash bargaining game to engage in what Heyes and Rickman call "regulatory bargaining" (Amacher & Malik: 1996). According to Amacher and Malik, in a two-party, cooperative Nash bargaining game, both parties will be better off if the regulator has the same objectives as society (i.e., wants to reduce the social costs of pollution) and if both parties cooperate when making their decisions. The model proposed by Amacher and Malik is, like Heyes and Rickman's model, in opposition to the traditional model of regulatory standard-setting, enforcement and compliance in which the regulator dictates standards to the polluter and the polluter follows the standards. The traditional model is what Segerson and Miceli seem to have in mind when presenting their bargaining power theory, and, unlike the Nash model, is a non-cooperative model in which the regulator leads and the firm follows, or vice-versa, depending on which party has more bargaining power.

Amacher and Malik also consider the fact that third parties can become involved in the bargaining process and affect the outcome, and incorporate this consideration into their model. A third party that has a fairly passive impact on the way a regulator weighs a firm's costs of

mitigation, for example, can be introduced into their model, or the authors can incorporate a third party that makes strict and unwavering demands, like an environmental lobbying group that refuses to accept anything less than the cleanest possible technology (Amacher & Malik: 1996, 250 - 251). Amacher and Malik do not state the effect that strong environmental or industrial lobbying would have on the outcome of their model, but they do state that third parties do, in fact, attempt to influence the pure two-party bargaining game.

Heyes and Rickman also test a variation of their model in which private individuals and environmental interest groups are allowed to file citizen suits against non-compliant facilities if the government fails to enforce regulations. Obviously, citizen suits might throw a cog in the gears of any regulatory body's strategic enforcement scheme, if such schemes exist. Their model suggests that, predictably, the threat of being sued by a non-governmental body reduces the value that an EPA "bribe" will have for a firm, since the violating firm may be judicially regulated by citizens even if its discretions are strategically ignored by the EPA (Heyes & Rickman: 1998, 370). The importance of their theoretical outcome to the empirical model of voluntary participation in the 33/50 Program presented in this paper is ambiguous, though, because high rates of Sierra Club membership (SCM_S) - which proxies for the level of citizens' bargaining power in environmental regulatory decision making - are shown to increase the rate of Program participation at the 10% level of significance, rather than lower the aggregate level of compliance/ participation, as the Heyes-Rickman model suggests would occur. This calls into question whether citizens suits and an environmentally active population are substitutes for EPA enforcement and standards, or complements. Does private activism have an independent positive effect on Program participation rates in states with uncoordinated EPAs, or do the two variables interact in some way? Answering this question is important for further interpretation of the $ASNC_S$ and SCM_S coefficient estimations, and an analysis of the problem is presented below.

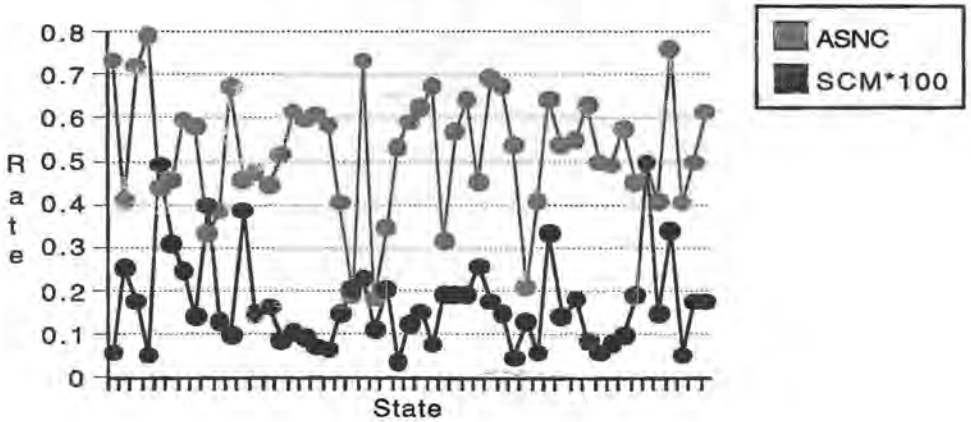
Perhaps $ASNC_S$ and SCM_S are not actually independent of one another; if they are substitutes, then an inactive EPA might motivate the public to become more environmentally vigilant, or maybe an active EPA makes the public less attentive to environmental problems. If the two variables are complements, then the two "regulators," one citizen-led and one EPA-led, either spur each other on or share a loose approach to enforcement. Heyes and Rickman do not propose

which relationship occurs more often, or to what effect, but they do comment on the potential for there to be a consistent complement or substitute relationship between the two forces (Heyes and Rickman: 1998, 371).

In an attempt to investigate the possible positive or negative correlations between public and private environmental vigilance, the state-by-state data for SCM_S and $ASNC_S$ can be compared; the results of this comparison are in Figure Two below. If public and private concern and enforcement are substitutes, then SCM_S should be high when $ASNC_S$ is low, and vice-versa. If they are complements, then the two variables should travel together. The values used to plot SCM_S are scaled to make the graph more readable (the SCM_S values used in the empirical model are multiplied by 100 for use in Figure Two).

The picture in Figure Two suggests that public and private environmental vigilance act as both substitutes and complements in the 50 states and the District of Columbia, if existing substitute/ complement relationships are anything more than statistical coincidence. According to the graph, $ASNC_S$ and SCM_S act as substitutes in 31 instances (61 percent) and complements in 20 instances (39 percent). There is no geographical pattern to the substitute/ complement relationship between the two variables.

Figure Two: ASNCs and SCMs



The $ASNC_S$ and SCM_S variables can also be mathematically tested for interaction. The regression output below allows for the possibility of an interaction between regulatory and citizen-led pressure on polluters. According to the output, the possible interaction between $ASNC_S$ and SCM_S is not significant to this model.

Summary Statistics

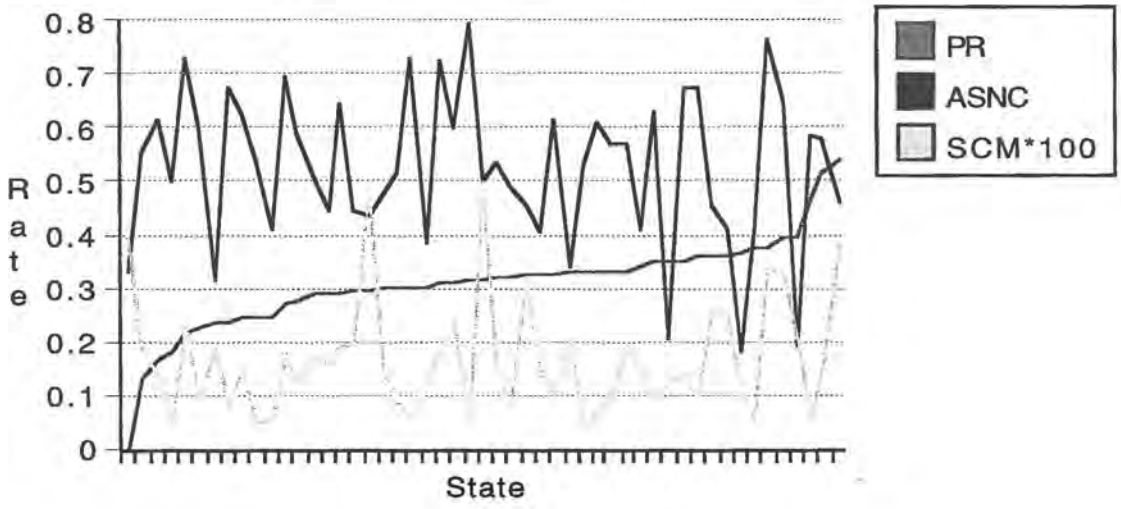
Interaction Test Model

$ASNC_S$	-0.107177
	(0.071319)
SCM_S	6.325905
	(10.81921)
$ASNC_S * SCM_S$	37.42257
	(88.06068)

More important than pinning down the relationship between the two sources of potential regulatory threat, though, is figuring out whether one type of relationship is more desirable than the other, i.e., whether a complementary relationship is associated with higher participation rates, or vice-versa. To test whether the nature of the relationship between $ASNC_S$ and SCM_S has anything to do with 33/50 Program participation rates, Figure Three plots those two variables with participation rates in ascending order. It appears that the relationship between public and private environmental vigilance has no relationship to state-level Program participation rates. It is not as though the states with a complementary $ASNC_S$/ SCM_S relationship are all states with lower participation rates, or vice versa. Heyes and Rickman might be correct, then, in failing to draw conclusions about the effect that the relationship between public and private enforcement has on firms' compliance decisions. This is a topic that would benefit from further empirical study. If there is some interaction between the EPA's level of vigilance and that of citizen groups like the Sierra Club, then perhaps that interaction could be exploited to increase polluters' compliance rates and reduce the social costs of monitoring, enforcement and abatement. It might be interesting to look at possible cause-and-effect links between socioeconomic variables and the relationship between public and private enforcement tendencies. Any lessons that could be drawn regarding a

clear trend would be useful in designing public policy and, in particular, regulatory strategies. The empirical model does indicate, though, that the EPA's actions have more consistent impacts on Program participation rates than do the active membership rolls of environmental citizens' groups, as $ASNC_S$ is significant below the 5% level, and SCM_S is significant below the 10% level.

Figure Three: PRs, ASNCs and SCMs

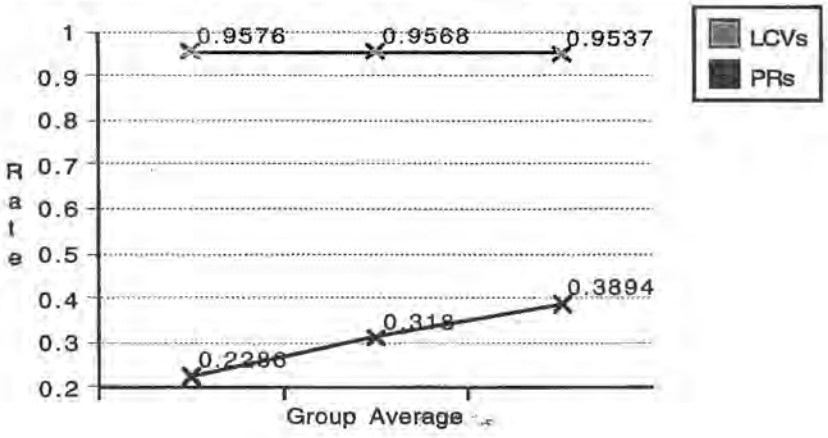


Amacher and Malik's paper, like Heyes and Rickman's, implies that $ASNC_S$ may not be an appropriate proxy for the bargaining power of the regulator, since the rate at which known violations are pursued may not accurately reflect the political might of the regulatory body. Both of these papers suggest that low levels of enforcement in one area of regulations might actually be used as leverage - bargaining power - to increase compliance in other areas. Perhaps the three EPA programs chosen for the $ASNC_S$ variable, EPCRA, TSCA and RCRA, are the standards "sacrificed" by the EPA in order to bribe firms into complying with other programs. If this is the case, then large values for $ASNC_S$ could signal a state in which the EPA does not bargain with regulated firms, and firms can therefore not be induced to voluntarily participate in the 33/50 Program. Again, this paper and model would benefit from further theoretical and empirical investigation into the relationship between enforcement of existing toxic waste mitigation programs and voluntary participation in an additional program, like the 33/50 Program, as well as possible strategies used by regulators.

The other curious outcome of this regression involves LCV_S, the variable that proxies the "greenness," or level of environmental consideration, of a state's delegation to Congress. Segerson and Miceli's bargaining power theory concludes that higher levels of perceived threat of mandatory regulation spur companies to voluntarily reduce emissions because compliance with mandatory abatement regulation is always more expensive than achieving the same levels of abatement voluntarily. Their model assumes that transaction (and enforcement) costs of mandatory compliance are always higher than those of voluntary abatement; this is a commonly accepted theory (Segerson & Miceli: 1998; Wu & Babcock: 1999; Khanna: 2001). Thus, it seems safe to presume that, the higher the rate with which a state's elected members of Congress vote in favor of protecting the environment, the higher the perceived threat of future mandatory legislation and the Program participation rate will be. The empirical results show that the opposite is true: the more often a state's U.S. senators and representatives vote in favor of environmental protection, the *less* likely firms within that state will be to voluntarily join the Program. If the League of Conservation Voters rating of Congress is in fact an accurate proxy for the environmental leanings of elected representatives, then the only possible explanation seems to be that the greenness of a state's Congressional delegation does not pose a threat to the state's manufacturing industries.

Perhaps this is true, that the link between federal government and environmental regulatory threat on the state level is not very strong. If this were the case but Segerson and Miceli's theory of regulatory threat remained true, though, the coefficient on LCV_S would have been insignificant, but positive. Instead, the coefficient is negative and significant. This suggests that passing formal, binding environmental legislation actually discourages participation in voluntary environmental programs. There is no available literature on the effect that the passage of new, mandatory environmental legislation has on participation in related voluntary programs, but one might hypothesize, in accordance with Heyes and Rickman's theory, that imposing new legislation removes some of the bargaining power held by the public regulatory body. If passing mandatory legislation is, in effect, making good on old regulatory threats, then passage would relieve some of the threat of legislation perceived by firms and thereby reduce the relative bargaining power of government. If, for example, a father threatens to make his daughter clean her room if she doesn't stop bothering her brother and ends up making her clean her room for another reason, then the daughter no longer has any incentive to stop pestering her brother. Similarly, a regulation that has been passed into law can no longer be held over polluters' heads as a potential threat. Figure Four illustrates the average trend in participation rates versus the "greenness" of government, or proxied level of legislative threat.

Figure Four: Potential Loss of Legislative Bargaining Power



While the negative relationship between PR_S and LCV_S is not as pronounced in Figure Four as the relationship between PR_S and $ASNC_S$ in Figure One, the empirical evidence does support the theory that Congress can bring about higher voluntary participation rates if it conserves some of its legislative bargaining power. This is another intriguing area of further analysis that would benefit the interpretation of this model's empirical results.

Empirical Conclusions

The results regarding public and private bargaining power, both the unexpected effects of $ASNC_S$ and LCV_S on participation rates and the as-expected signs of the coefficient estimations of the variables proxying industry bargaining power (PME_S and $PSIC_S$), are interesting because they complicate some aspects of the model's theoretical foundation. Segerson and Miceli's theory of bargaining power that does not allow for cooperative, strategic bargaining is called into question by the fact that states with seemingly more pro-environment legislators and regulators have lower Program participation rates than seemingly less eco-oriented enforcement and legislative threats, all other factors held constant. These results, coupled with the theoretical models of strategic regulatory enforcement, suggest that cooperative bargaining between the regulator and the regulated has a positive effect on participation rates in the 33/50 Program and, possibly, other voluntary programs. Moreover, the negative coefficients on $ASNC_S$ and LCV_S lend credence to a bargaining theory in which the regulator and the legislative body hold on to their enforcement and mandatory regulatory chips, as it were, in order to gain an advantage at the compliance/ voluntary participation bargaining table. The data on enforcement vs. participation rates in Figure One and legislative "greenness" vs. participation rates in Figure Four provide cursory visual evidence of this theory in action in the real world. Private environmental interest groups and candidates for elective office often tout the benefits of a regulatory body that is not willing to make deals with polluters. This may sound like a good idea from a rhetorical and political standpoint, but if it results in less-than-maximal compliance rates and higher overall costs to society, is it really in the best interests of the public? Maybe not, the alternative strategic bargaining theory suggests.

More empirical research needs to be done to identify incidences of environmental

regulatory bargaining in the real world, and to test the effects of such bargaining on total steady compliance rates, pollution abatements and social costs. In particular, further research might expose a low point of enforcement past which the regulator ceases to be a threat because it never or very rarely enforces *any* laws or pursues *any* cases of non-compliance. On the flip side, further investigation might also illuminate a high point of enforcement past which firms will begin to have higher participation rates as the enforcement level increases. This latter situation would theoretically only occur if the fees or other costs of non-compliance were raised beyond the costs of compliance for all firms.

It remains unclear whether or not there is a consistent relationship between regulatory enforcement strategies and environmental vigilance and/ or judicial action on behalf of citizens, and how a possible relationship might affect voluntary participation rates. The empirical evidence nonetheless shows that the rate of Sierra Club membership, as a proxy for citizens' environmental vigilance, has an overall positive effect on Program participation, although its significance is not as great as was expected. Again, the possibility that activists' and regulators' strategies for inducing firms to comply with regulation is intriguing, and deserves further attention. If such a substitute or complementary relationship is empirically proven to exist, then perhaps it could be used to bring about high rates of voluntary action at low costs to society.

Chapter Five

What Impact Does This Evidence Have on Climate Policy?

This paper began with a discussion of climate change, the nascent state of climate policy and firms' motivations for voluntarily reducing carbon dioxide emissions, but a lack of data on the firms and emissions reduction credit trading (ERC) systems forced the empirical analysis to focus on firms' motivations for voluntary compliance in another area, that of toxic chemical use. The empirical results can be used, though, to identify the "pressure points" that should be pushed in order to make the greatest gains in voluntary compliance with GHG abatement programs and, therefore, the greatest aggregate reductions in GHG emissions. The interpretation of the relevant variables in the context of potential voluntary or mandatory climate policy is given below.

Some of the variables used in the empirical model are of little practical relevance to bureaucrats and businesspeople who want to design voluntary GHG abatement policies. The unemployment rate, for example, is not exactly a "pressure point" that can or should be exploited to increase the rate of volunteerism. Politicians, no matter how environmentally conscious an electorate they hope to represent, are unlikely to campaign on the basis of rising unemployment rates and falling impacts on global warming. Moreover, climate change can be addressed without pushing people out of their jobs. Similarly, macroeconomic factors like the index of the change in manufacturing employment ($IMEC_S$) are of limited use to policy makers. Changing a macroeconomic variable like the size of the manufacturing industry within a state involves actually moving those companies and jobs to other states or countries, and simply moving a factory to somewhere else does not actually reduce global GHG emissions. Some pundits who profess to be climate change authorities say that moving U.S. industry overseas not only lowers the cost of goods to U.S. consumers, but also reduces U.S. contributions to climate change. While U.S. firms would technically be belching out less pollution if industry was shipped overseas, such commentators do not understand the systematic nature of the climate change issue. Even though the emissions would not be produced on American soil, the goods would be made in factories in developing countries, which tend to have lower pollution standards than the United States, and shipped here in vehicles powered by fossil fuels. And, as was previously mentioned, eliminating

U.S. jobs is usually not a selling point for any policy.

There are industrial factors which affect voluntary participation rates that can be utilized in promoting voluntary emissions reductions, though. A company that is expanding its facilities, or a new company that is setting up shop, may find itself well positioned to join a permit trading program, as the positive result for the estimated coefficient on the manufacturing capital expenditures over value of sales variable (CEV_S) indicates. While this variable is not found to be significant in the model, it could *become* a significant driver of participation if new firms or firms undertaking capital improvements were actively recruited to join trading programs. And, if a trading program is used as part of mandatory GHG legislation, then firms buying new capital would have a strong incentive to purchase the "cleanest" equipment possible, assuming the marginal cost of the cleaner-running equipment is lower than the marginal cost of compliance, if it costs more at all. As was stated in the theoretical section of the paper, though, the costs of non-compliance perceived by polluters should go up as the threat of mandatory regulation increases, which would make the additional expense of emissions-saving investments seem like less of a barrier.

The size of a company, according to this analysis and many others, is a contributing factor to the participation decision. Policies that focus on bigger companies, at least initially, will have higher rates of voluntary compliance. This happens for a number of reasons. For example, large firms tend to have more funds earmarked for specialized projects and they often attract more public/ stakeholder scrutiny (and praise, in the case of BP). In other words, large firms see greater net benefits to participation than do small- and medium-sized firms. Large firms also tend to have more funds on hand to finance non-essential projects than small- or medium-sized firms. Promoting a voluntary abatement strategy among large firms might also make smaller firms take notice and want to get on board, according to theories of corporate and industry leadership.

The original hypothesis of this paper states that voluntary participation can be motivated by increasing the strength of the regulatory body's threat of mandatory legislation relative to the industry's strength to resist such legislation. The counterintuitive empirical results, however, reveal the presence of a more complicated system of threats, enforcement and industry power. If the results given by the model are accurate, and if an EPA and Congress that are tough on polluters represent regulatory bargaining power, then the last thing environmentalists would want is more

"bargaining power," since voluntary industry participation would decrease! The simpler theory of bargaining power does not seem to produce the desired results in the real world.

It should be mentioned again that the theory advanced by Heyes and Rickman depends on, among other things, the (accurate) assumption that the expected penalty for non-compliance that a polluter faces is lower than the cost of compliance (Heyes & Rickman: 1999, 362). This begs the question: why not simply impose mandatory legislation for carbon dioxide emissions and set the penalties for non-compliance higher than the costs of compliance? The answer is that politics controls legislation in the United States, and the negative and strongly significant coefficients on the variables for the manufacturing industry's regulatory/ political clout within a state (PME_S and $PSIC_S$) give evidence of the sway that polluters seem to have over public policy. Witness President George Bush and Vice President Dick Cheney: since gaining office three years ago, the two have often been accused of being beholden to fossil fuel interests and, lo and behold, removing the United States from the Kyoto treaty was one of the first things Bush did in office. While the PME_S and $PSIC_S$ variables are negatively correlated with Program participation rates at the one percent level of significance, AVR_S and SCM_S are positively correlated with participation rates at the 10 percent level of significance: individual citizens have little power against big industrial interest groups. In addition, $ASNC_S$ and LCV_S, variables intended to proxy the regulatory and legislative threat levels, have negative and strongly significant coefficients: the forces that are supposed to impose limits on pollution are forced, in part because of penalties set lower than compliance costs, to bargain with violators to achieve the highest possible level of compliance. The results of the empirical model suggest that, at least in the case of toxics regulation, manufacturers hold the majority of the bargaining power. The results and theory imply that regulators are forced to strike a deal with regulatees, not the other way around.

It is highly likely that, in the context of the alternative and more complex bargaining theory introduced in the empirical analysis, the $ASNC_S$ and LCV_S variables turn out to have negative impacts on Program participation rates because higher enforcement rates and higher pro-environment voting averages are actually representative of reduced governmental bargaining power, not of legislative or regulatory threats of stricter pollution standards. Posing a threat to polluters is still necessary, according to the model, but the threat that the EPA and Congress poses to polluters

essentially comes from having their hands tied. The empirical results show that the EPA and Congress will never be able to pose more than weak threats which, according to Segerson and Miceli's paper, is a condition that will always yield low levels of pollution abatement (Segerson & Miceli: 1998, 128). If the alternative theory of strategic bargaining holds true, then legislators who want to see climate change policy enacted should not actually *pass* laws regulating emissions, just *propose* them. Even if this strategy poses a threat to industry at first, there is likely to be a point at which the threat breaks down; this possibility needs to be investigated further. If legislators are more concerned with retaining their bargaining power than setting the aggressive GHG emissions reductions needed to mitigate the potential threat of climate change, then the ultimate crisis may not be averted. Due to the nature of the problem and the short timeframe in which reductions on the order of 70 percent below 1990 emissions levels must be made, the typical political strategy of "muddling through" will not be enough to get the job done.[37]

But what if Congress and the EPA - and the public - actually did represent serious regulatory threats rather than minor players in one of the most important games that public policy has ever had to play? The only way to change the roles of the players is to change the rules of the game. Emissions permit trading plays the regulatory game from another angle: rather than raise the price of the penalty, a well-designed trading system would simply lower the costs of compliance until the benefits of compliance outweigh the costs, and even turn some of those costs *into* benefits through the sale of excess permits. If politics is not going to address the problem of climate change quickly and effectively, then market forces must be utilized to avoid potential catastrophe.

It might be productive to eliminate the entire concept of "bargaining power" in regulation altogether and replace it with the notion of "market incentives." Rather than raise the penalty for non-compliance, regulators should lower the total costs of compliance in a variety of ways while maintaining ambitious abatement targets. Emissions trading provides an opportunity to change the nature of pollution control by giving firms a flexible way to reduce aggregate emissions at marginal costs lower than the costs of compliance with a command-and-control abatement program that has comparable reduction targets (Wu & Babcock: 1999; Segerson & Miceli: 1998). A voluntary emissions trading program changes the very meaning of regulation because rather than imposing rules and technology standards that must be followed to the letter, the organizer of a voluntary

agreement simply sets an abatement goal and provides a framework in which participants can freely buy and sell emissions reduction credits to achieve compliance with the target. Such a program need not be voluntary, and it might in fact yield even more significant emissions reductions if the abatement targets are supported by the law. The EPA's Acid Rain Program, for example, has more than achieved its goals, and firms have been actively trading in ERCs. Given the presence of the inherently imbalanced and overly politicized power relationship between regulators and polluters, perhaps the "stick" approach to regulation should be abandoned in favor of "carrots"; incentives, rather than penalties, should be emphasized. Emissions trading is a policy model that uses carrots before it uses sticks: firms can not only avoid penalties, but can also make money by reducing emissions beyond the required level. The effectiveness of permit trading in terms of the volume of GHGs abated depends on the structure of the program, the price of a permit and a number of other factors that could fill a research paper of their own.

In conclusion, the bargaining that public officials and private firms engage in now can be avoided, and significant reductions in greenhouse gas emission made, if the costs of compliance with either a voluntary or a mandatory abatement target are brought to a point lower than the benefits of participation in such a program. The results of the empirical model reveal that, currently, having the "bargaining power" of the regulator outweigh the bargaining power of the regulatee actually actually means strategic and incomplete enforcement of existing mandatory environmental programs and passage of little, if any, new legislation. This is a game in which the regulator and, by extension, the public, only wins by remaining beholden to polluters and their private cost functions. If the fundamentals of this game can be changed so that the public and private interest work in progressive unison, then rational, profit-maximizing firms would have no incentive *not* to reduce their GHG emissions. By targeting the bigger firms first and encouraging those firms to lead their respective industries; by providing incentives for companies to install cleaner and more energy-efficient equipment when capital comes up for replacement; by encouraging firms to produce products and services for environmentally minded consumers and communities; and by endorsing a policy or program whereby those firms that go beyond compliance can actually profit from their efforts, policy makers can begin to construct an incentive framework to induce sizable voluntary reductions in the emission of greenhouse gases.

ENDNOTES

[1] For a list of the companies that are participating in actual voluntary trades of carbon dioxide and carbon dioxide equivalents, or of companies that are working to design selected trading systems, please consult the List of Voluntary Participants in the Appendix.

[2] International Emissions Trading Association official website. Full list of members and their regional distributions. Online: <www.ieta.org> Nov. 12, 2002.

[3] For a complete listing of the countries and international governing bodies that have GHG abatement programs registered with the International Emissions Trading Association, please consult the list of Countries and International Government Bodies Engaged in Emissions Reductions in the Appendix.

[4] CO2e.com. "Market History." Available online: <www.CO2e.com/trading>. Accessed 11/9/02.

[5] PriceWaterhouseCoopers. "Climate Change Strategic Services." PDF. Available online: <www.co2e.com/strategies/lists.asp?intcategoryid=11> Accessed 11/16/02.

[6] Please consult the Appendix for a list of the Founding Members of the Chicago Climate Exchange.

[7] Please see Countries and International Governing Bodies Engaged in Emissions Reductions in the Appendix.

[8] U.S Environmental Protection Agency. Clean Air Markets. Available online: <www.epa.gov/airmarkets/cmprpt/arpol/index.html>. Accessed Feb. 15, 2003.

[9] Frey: 2002; International Emissions Trading Association official website. IETA's Trading Scheme Database. Online: <http://www.pointcarbon.com/schemes.php> Nov. 12, 2002.

[10] BP. Official website. Available online: <www.bp.com/environ_social/case_studies/north_america/index.asp> Accessed Feb. 17, 2003.

[11] Taxpayers for Common Sense. Official website. Available online: <www.taxpayer.net/TCS/fuelsubfact.htm. Accessed Feb. 17, 2003.

[12] For a list of the domestic GHG regulatory actions of foreign countries and international agencies, please see Countries and International Governing Bodies Engaged in Emissions Reductions in the Appendix.

[13] For a description of BP's internal trading program, please consult BP's Internal Trading Program in the Appendix.

[14] For a detailed description of BP's internal emissions reduction and permit trading programs, please consult BP's Internal Trading Program in the Appendix.

[15] Arora and Cason do not delve into whether poverty causes an area to be polluted or existing pollution causes an area to be populated by poor people, but the general conclusion that high levels of pollution and wealthy populations don't mix still holds true.

[16] U.S. Environmental Protection Agency. "33/50 Program: The Final Record." Office of Pollution Prevention and Toxic. Ref. #: EPA-745-R-99-004. March 1999. Available online: <http://www.epa.gov/opptintr/3350/33fin04.htm> Accessed 13 Nov. 2002.

[17] *Ibid.*

[18] Arora and Cason: 1995, 276.

[19] Data Source: U.S. Environmental Protection Agency, Office of Enforcement and Compliance Assurance. "FY 1991 - FY 1996 State-by-State Enforcement Data Summaries." August 2000.

[20] U.S. Environmental Protection Agency website. Enforcement Programs. Available online: <www.epa.gov/compliance/civil/programs/index.html> Accessed 12 Feb. 2003.
[21] Data Source: U.S. Census Bureau. 1990 U.S. Census. Available online: <www.census.gov> Accessed 12 Jan. 2003.

[22] Data Source: League of Conservation Voters. 1989 - 1995 National Environmental Scorecards. Available online: <www.lcv.org/scorecard/archive.asp> Accessed 16 Nov. 2002.

[23] Data Source: Sierra Club State-by-State Membership 1990 - 1996. Spreadsheet, obtained via e-mail from the Sierra Club. Data Source: U.S. Census Bureau. ST-99-3: "State Population Estimates: Annual Time Series, July 1, 1990 to July 1, 1999." Dec. 29, 1999. Available online: <eire.census.gov/popest/archives/state/st-99-3.txt> Accessed 15 Jan. 2003.

[24] Data Source: Associated Press. "Political Inclination of the States." Jan. 9, 2003. Available online: <www.boston.com/dailynews/009/region/Political_inclination_of_the_sP.shtml> Accessed 9 Jan. 2003.

[25] Data Source: League of Conservation Voters. 1989 - 1995 National Environmental Scorecards. Available online: <www.lcv.org/scorecard/archive.asp> Accessed 16 Nov. 2002.

[26] Data Source: U.S. Census Bureau. 1990 U.S. Census. Available online: <www.census.gov> Accessed 12 Jan. 2003.

[27] U.S. Environmental Protection Agency. "33/50 Program: The Final Record." Office of Pollution Prevention and Toxic. Ref. #: EPA-745-R-99-004. March 1999. 4. Available online: <http://www.epa.gov/opptintr/3350/33fin04.htm> Accessed 13 Nov. 2002.

[28] Arora and Cason: 1995.

[29] U.S. Census Bureau. 1995 Annual Survey of Manufactures: Geographic Area Statistics." April 1997. Available online: <www.census.gov/prod/2/manmin> Accessed 16 Jan. 2003.

[30] For a complete description of BP's internal GHG emissions trading program and program results, please consult BP's Internal Trading Program in the Appendix to this paper.

[31] Data Source: U.S. Census Bureau. 1995 Annual Survey of Manufactures: Geographic Area Statistics." April 1997. Available online: <www.census.gov/prod/2/manmin> Accessed 16 Jan. 2003.

[32] U.S. Department of Labor Bureau of Labor Statistics. "Geographic Profile of Employment and Unemployment." Available online: <data.bls.gov/cgi-bin/surveymost?.gp> Accessed 18 Jan. 2003.

[33] Data Source: U.S. Census Bureau. 1995 Annual Survey of Manufactures: Geographic Area Statistics." April 1997. Available online: <www.census.gov/prod/2/manmin> Accessed 16 Jan. 2003.

[34] This restricted model is the final model that will be used for further analysis.

[35] From this point forward, the "old" restricted model, the model that omits the dummy variable $PDUM_S$, will be referred to as "the model," and its regression results used in the subsequent analysis.

[36] The data used in the model could have been scaled before running the regressions. However, the size of the coefficients can be made more easily comparable without affecting interpretations of significance by scaling the coefficients in line with how the raw data could have been scaled.

[37] The Intergovernmental Panel on Climate Change (IPCC) states that total GHG emissions levels must be reduced by this amount in order avoid the detrimental effects of global climate change. The need for this quantity of reductions stems primarily from the fact that carbon dioxide and other greenhouse gases are persistent, and can stay in the atmosphere and continue to heat the planet for up to hundreds of years (IPCC 2001; IPCC 2001b).

APPENDIX

Voluntary Private-Sector Participants: This list represents a nearly complete sampling of the private, for-profit companies that are either helping to design a GHG emissions trading program, are engaged in an existing trading system, or both. The companies are listed in alphabetical order, and are paired with their associated trading program(s).

Key: CCX = Chicago Climate Exchange (www.chicagoclimatex.com)
CO2e.com = CO2e.com/ Cantor Fitzgerald (www.CO2e.com)
IETA = International Emissions Trading Association (www.ieta.org)
Pew Center = The Pew Center for Global Climate Change (www.pewclimate.org)

Firm	Trading Programs/ Association
ABB	Pew Center
Air Products and Chemicals Inc.	Pew Center
Alcan	IETA
Alcoa	Pew Center
Alliant Energy Corp.	CCX
American Electric Power	CCX, IETA, Pew Center
Atomic Energy of Canada Ltd.	IETA
Baker & Mackenzie Solicitors and Attorneys	IETA
Baxter	Pew Center
Boeing	Pew Center
BP/ BP America	CCX, CO2e.com, IETA, Pew Center
Cemex	CCX
CHZM HILL	Pew Center
Cinergy	CCX, Pew Center
CMS Generation Co.	CCX
CO2e.com	IETA
Davies Ward Phillips & Vineburg LLP	IETA
DeBrauw Blackstone Westbroek	IETA
Det Norske Veritas (DNV)	IETA
Deutsche Börse	IETA
Deutsche Telecom	Pew Center
DTE/ DTE Energy	CCX, Pew Center
DuPont/ DuPont Canada	CCX, CO2e.com, IETA, Pew Center
EmC Emission Control s.r.l.	IETA
Encana	IETA
Endesa Trading	IETA
Entergy	Pew Center
Enterprises pour l'Environment	IETA

Firm	Trading Programs/ Association
Environmental Resources Management	IETA
Eskom	IETA
ESP	IETA
Evolution Markets	IETA
Exelon Corp.	CCX
First Energy Corp.	CCX
Ford Motor Company	CCX, CO2e.com
Gaz de France	IETA
Georgia-Pacific	Pew Center
Grupo IMSA, SA de CV	CCX
Holcim	Pew Center
IBM	Pew Center
Industrial Technology Research Institute	IETA
Innovation & Technology Center/Roscom	IETA
Intel	Pew Center
Interface Inc.	Pew Center
International Paper	CCX
John Hancock	Pew Center
KPMG	IETA
Lafarge	IETA
Lloyds Register	IETA
LockHeed Martin	Pew Center
Manitoba Hydro	CCX
Maytag	Pew Center
MeadWestvaco Corp.	CCX
Midwest Generation EME, LLC	CCX
Natsource	IETA
NiSource	CCX
Norsk Hydro/ Norsk Hydro ASA	CO2e.com, IETA
Norsk Hydro ASA	IETA
Novartis	Pew Center
Nuon	IETA
Ontario Power Generation	CCX, CO2e.com, IETA, Pew Center
PG & E Corp./ National Energy Group	CCX, Pew Center
Pinnacle West Corp (APS)	CCX
Point Carbon	IETA
PricewaterhouseCoopers	IETA

Firm	Trading Programs/ Association
PT. Indonesia Power	IETA
Rio Tinto	Pew Center
Rohm and Hass	Pew Center
Royal Dutch/ Shell Group/ Shell International	CO2e.com, IETA, Pew Center
SC Johnson	Pew Center
SGS Sociéte Généralé de Surveillance SA	IETA
ST Microelectronics, Inc.	CCX
Statoil	CO2e.com, IETA
Stora Enso North America	CCX
Süddeutschland	IETA
Suncor Energy	CCX, CO2e.com, IETA
Sunoco, Inc.	Pew Center
SwissRe	IETA
Temple-Inland Forest Products Corp.	CCX
Texaco	CO2e.com
Tokyo Electric Power Company (TEPCO)	CO2e.com, IETA
Tokyo Mitsubishi Securities	IETA
TotalFina Elf	IETA
Toyota	Pew Center
Tractebel	IETA
TransAlta	IETA, Pew Center
TUV	IETA
TXU Energy Trading Co. LP	CCX
United Technologies	Pew Center
Unocal	IETA
Waste Management Inc.	CCX
Weyerhaeuser	Pew Center
Whirlpool	Pew Center
Wisconsin Energy Corp.	CCX, Pew Center
Woodside Energy	IETA
Xlaunch	IETA

Countries & International Governing Bodies Engaged in Emissions Reductions: This table shows the countries and international agencies that are monitored by the International Emissions Trading Association (IETA). This table also provides brief descriptions of the trading program(s) that exist within each country and international governing body, as well as the program(s) planned for the future. The information is from the IETA database, which can be searched in more detail at: *http://www.pointcarbon.com/schemes.php?sysselect%5B%5D=-1&keywords%5B%5D=nature&submitbutton=Show+results.* In most cases the program descriptions are taken directly from the IETA's databases, while other have been paraphrased.

Country/ International Agency	Program/ Proposal Descriptions
Australia	Proposed national cap-and-trade system.
Australia - New South Wales	Emissions trading scheme building on an existing emissions benchmarking program in connection with electricity retailer licensing conditions.
Canada	Plan includes emissions trading for large industrial emitters, increased invest in innovative technologies and taxes.
Canada - CleanAir Canada/ PERT	The Pilot Emissions Reduction Trading Project (PERT), now CleanAir Canada, is a self-funded non-profit organisation allowing its members to register and trade emission reductions through its registry.
Canada - GERT	The Greenhouse Gas Emissions Trading Pilot (GERT) is a voluntary partnership where participants can register abatement projects and trade carbon offsets. Projects are registed in Canada's Climate Change Voluntary Challenge & Registry.
Czech Republic JI	JI program initiated by the Czech Republic.
Denmark	Domestic cap and trade scheme. Legal basis in the CO2 Quota Act passed in 2001.
European Union	Proposed community wide cap and trade system. Note that this section builds on the current proposal and that a final system, if approved, could be subject to substantial changes.
France	Voluntary industry-government agreements. Came about as an alternative to the broad-based national energy tax (a previous energy tax proposal was deemed unconstitutional by the European Council in December 2000).
Germany	Voluntary agreements are preferred over a trading approach. A 3-year pilot trading system has been described in an issue paper written by a government-appointed working group on emissions trading.

Country/ International Agency	Program/ Proposal Descriptions
Japan	A trial system for trading of GHG emission rights is planned for 2003. A voluntary GHG emissions registry is also being planned.
Korea	Korea will establish a national greenhouse gas emission registry system by 2004 and adopt an international carbon dioxide emissions trading (ET) system at a later stage.
NAFTA	Potential cross-border trading system proposed in a working paper by an expert advisory board to the Commission for Environmental Cooperation (CEC) of North America. Industry roundtables have also discussed trilateral trading schemes.
Netherlands	Proposal for national trading scheme. The scheme resembles the proposed EU cap and trade scheme, moving away from the first proposal by the Dutch CO2 Trading Commission (Vogtländer Commissie).
Netherlands - CAF	An agreement between the Netherlands and CAF to establish a facility that will purchase GHG emission reduction credits.
Netherlands - CERUPT	The Certified Emission Reduction Units Procurement Tender (CERUPT) is a CDM procurement scheme where the Dutch government purchases GHG emission reductions in non-Annex 1 countries from companies from all over the world.
Nertherlands - ERUPT	The Emission Reduction Units Procurement Tender (ERUPT) is a JI procurement programme where the Dutch government purchases GHG emission reductions from companies from all over the world. The scheme functions on a tender basis with shortlisting.
Netherlands - IBRD	An agreement between the Netherlands and the IBRD to establish a facility that will purchase GHG emission reduction credits.
Netherlands - IFC	An agreement between the Netherlands and the IFC to establish a facility that will purchase GHG emission reduction credits.
Norway	Domestic cap and trade system.
Slovakia	Proposed domestic CO2 emissions trading system. To be fully compatible with the proposed EU cap and trade scheme.
Sweden	Proposal for a national trading scheme to replace the CO2 tax which is planned to be phased out by 2005. Swedish climate change strategies dictate that the system should be fully compatible with the EU system.

Country/ International Agency	Program/ Proposal Descriptions
Switzerland	A voluntary system for CO2 emissions reductions.
United Kingdom	National voluntary cap and trade.
USA - Clean Power Group	Multipollutant legislation with cap and trade system proposed by the Clean Power Group, consisting of the companies NiSource, Calpine, Trigen, and El Paso. Enron used to be a member of the group but is no longer on the membership list.
USA - Climate Stewardship Act of 2003	A bipartisan bill introduced by senators Joe Lieberman and John McCain in a U.S. Senate hearing in January 2003. The bill proposes a U.S. wide cap-and-trade system with an accompanying national greenhouse gas database.
USA - Massachusetts	Multipollutant legislation setting emissions standards for power plants. Draft regulations for a market based approach are expected later in 2002.
USA - New Hampshire	The proposed New Hampshire Clean Power Strategy, released in January 2001, places caps on emissions from electricity generation.
USA - New Jersey	The New Jersey Open Market Emissions Trading (OMET) program and a GHG Trading Protocol Project.
USA - Oregon	Oregon requires new power plants to meet CO2 emissions standards in order to receive site certificates. Oregon established the Cliamte Trust to implement CO2 offset projects, which may be used in future GHG regulatory or trading systems.
World Bank - BioCF	The BioCF aims to deliver cost-effective abatement and promote biodiversity conservation and sustainable development by financing demonstration sequestration projects in forest and agro-ecosystems.
World Bank - CDCF	Multilateral initiative launched by the World Bank in collaboration with the IETA. The fund will provide finance for reducing GHG emissions to small-scale projects in small developing countries and rural areas of all developing countries.
World Bank - PCF	Multilateral initiative for project financing intending to generate high quality emission reductions from CDM/JI. The system operates under a closed-end mutual fund structure.

Founding Members of the Chicago Climate Exchange: This table lists the fourteen founding members of the Chicago Climate Exchange. The founders were announced in January of 2003. These 14 companies, and the City of Chicago, have agreed to reduce their GHG emissions 1 percent below baseline in 2003, 2 percent in 2004, 3 percent in 2005 and 4 percent below baseline in 2006. The baseline is set as the average of annual emissions from 1998 through 2001 for each participant. (www.chicagoclimatex.com)

Founding Members of the CCX
American Electric Power (AEP)
Baxter International Inc.
City of Chicago
DuPont
Equity Office Properties Trust
Ford Motor Company
International Paper
Manitoba Hydro
MeadWestvaco Corporation
Motorola, Inc.
STMicroelectronics
Stora Enso North America
Temple-Inland Inc.
Waste Management, Inc.

BP's Internal Trading Program[1]

In 1998, BP Chairman and CEO Lord John Browne committed the company to reductions in "direct equity share" GHG emissions to 10 percent below the 1990 level. "Direct equity share" emissions are all of the GHG emissions produced by facilities BP owns completely plus the percent of emissions produced by partially BP-owned facilities, in proportion to BP's percentage of interest in these facilities. The 1990 baseline was 90.1 million tons (revised for the December 31, 1998 merger with Amoco, which increased the baseline number of emissions), and in 2001 BP reported emissions totaling 80.5 million tons, a reduction of 9.6 million tons, or 10.6 percent less than 1990 levels. Their reductions have been corroborated by outside auditors. BP also charged

[1] Information for this section of the Appendix comes from: BP Official Website. Climate Change: Our Performance. Available online: <www.bp.com/environ_social/environment/climate_change/our_performance/index.asp> Accessed Feb. 19, 2003.

itself with reducing 2001 GHG emissions by 2 percent over the course of the year, and was more than successful. The company estimates that, on a net-present-value basis over eight years, the fuel designed out of operating processes is worth about $650 million.

BP achieved these impressive reductions using three main strategies: operational reduction, investment in capital projects and an internal ERC trading system. Figure One below, "greenhouse gas emissions reductions," shows where operational reductions were obtained in 2001. BP's ERC trading system links every BP operational site in the world through an internal website on which carbon dioxide credits are bought and sold among the different facilities. The year the trading program began, in 2000, 2.7 million tons of carbon dioxide were traded at an average price of $7.60 per ton. In 2001, 4.55 million tons of carbon were traded, and the average price was over four times higher than it was in 2000, and stood at $39.63 per ton. Per-ton prices in 2001 were volatile, too, ranging from $7 in January to $99 in September. Figure Two below, "carbon dioxide equivalent vintage: 2001 traded prices" charts the internal selling price of a ton of carbon dioxide over the course of 2001. Analysts at BP have concluded that the higher prices reflected stricter abatement targets set for 2001, which caused shortages of sellers at a few points during the year. The analysts also believe that those market conditions were caused in part by inaccurate forecasting of year-end abatement positions. BP plans to continue to operate its internal trading system as a teaching tool, and to plan additional internal and external emissions trading schemes.[2]

[2] *Ibid.*

Figure One[3]

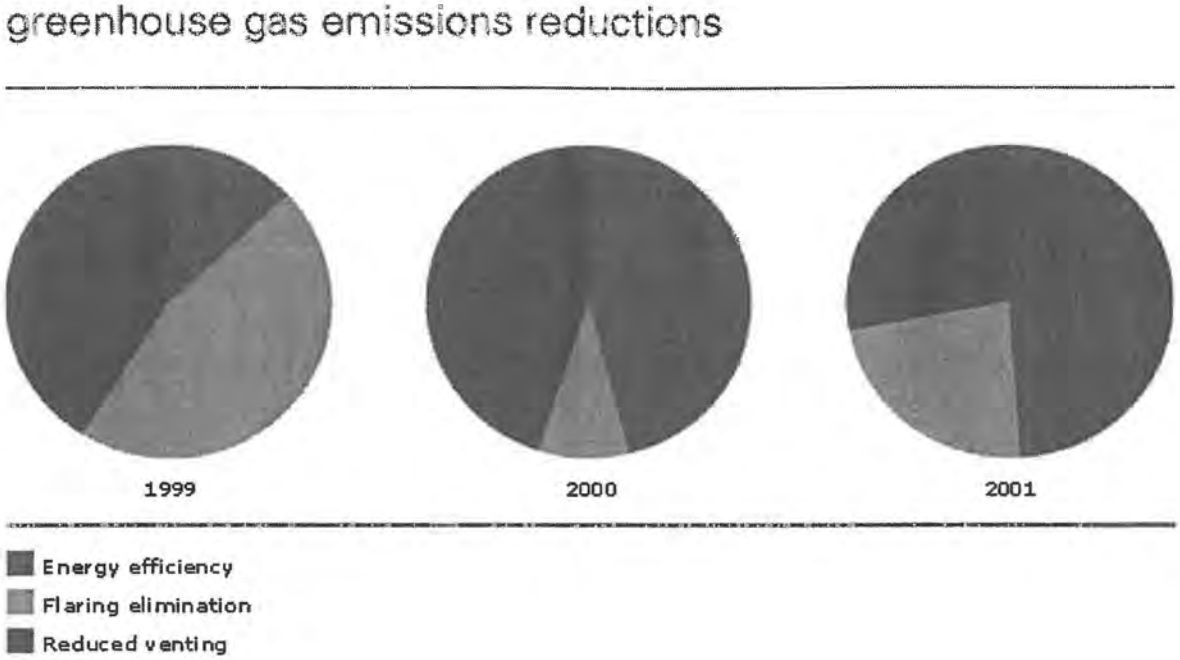
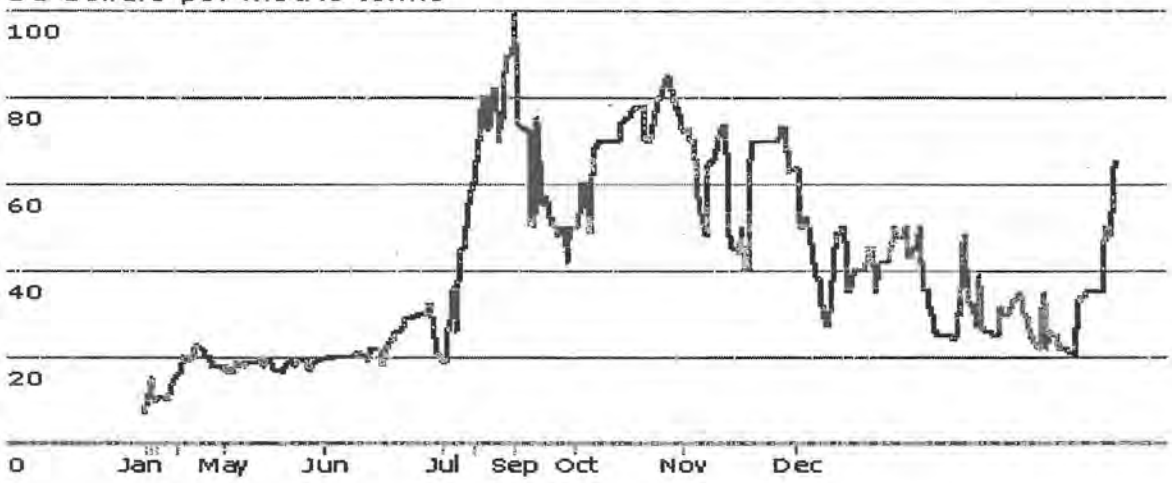


Figure Two[4]

[3] Chart copied from: BP Official Website. Climate Change: Our Performance. Available online: <www.bp.com/environ_social/environment/climate_change/our_performance/index.asp> Accessed Feb. 19, 2003.
[4] *Ibid.*

carbon dioxide equivalent vintage:
2001 traded prices

US dollars per metric tonne



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