

“The Challenges of Valuing Carbon”

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I. Introduction

Economists have an abiding faith in the power of markets to efficiently allocate scarce resources on the basis of accurate prices for goods and services. Prices that distort market behavior are generally believed to result in net economic loss to society and to create challenges for policy-makers. How can a policy-maker determine the regulatory regime that most efficiently reaches policy goals if the underlying value of the resources at play are inaccurately reflected by market prices? Unfortunately, getting the price right is often easier said than done, particularly when an accurate price must also incorporate the value of the resource to future generations.

When it comes to pricing, perhaps no resource has proven harder to deal with or created more controversy than the pricing of what could loosely be termed “clean” air. This is especially true when considering the effect of the category of air pollutants termed Greenhouse Gases,¹ which for simplicity we will collectively refer to as “carbon.” While a clear political consensus has emerged in both Washington and much of the world that an overall reduction in carbon would benefit the planet, there is no comprehensive agreement on how to establish, measure, and achieve that goal. This lack of agreement is undoubtedly influenced by the lack of consensus on what a ton of carbon reduction is worth – in other words, the market price for a ton of carbon

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reduction. For example, prices which emerge from cap and trade markets and emissions tax regimes demonstrate significant variance, and often appear to be influenced more by political acceptance and the idiosyncratic rules of the specific market mechanism than a careful measurement of the costs and benefits of the carbon reduction.

There is a significant body of literature related to the available mechanisms for regulating carbon emissions in the United States. Two likely candidates have emerged: a cap and trade system and a carbon tax. Both methods have benefits and challenges, as well as potentially differing results when measured in terms of effectiveness in attaining carbon reductions, ease of administration, transparency and fairness. What is striking about these two alternatives, however, is that they both pre-suppose a level of carbon reduction that has already been determined to be optimal. Under a tax, the regulator would estimate the amount of tax necessary to achieve a given level of carbon reductions. In a cap and trade system, the regulator would set the total amount of permitted carbon emissions (presumably at a level requiring reductions) and participants would adjust their behavior to stay under that cap. But neither mechanism explains *where* to set the level of carbon reductions or *why* it should be set at that level.

In a normally functioning market in perfect competition, there would be no need to set a level of carbon reductions because the market itself would reach an equilibrium level that was efficient, based on the value, or demand, of carbon reductions compared with the availability, or supply, of carbon reductions. The market would reveal the efficient price, and through the price the efficient quantity, of carbon reductions. Unfortunately, not all markets are perfect, and the market for carbon reductions (assuming one even exists) is particularly tricky. Although much

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attention has been paid to how to manipulate this market, less attention has been paid to how the market actually looks. What is the value of one unit of carbon reduction at a given quantity of emissions? Or, in other words, what is its price? This is not a value we expect to see clearly reflected in the market for carbon reductions, but rather one that we must take some efforts to discern.

The difficulties in pricing carbon reductions are not just esoteric mind-games for the curious economist. The inability to accurately establish the price of carbon reductions undermines the effectiveness of a carbon reduction regime, with potentially catastrophic consequences. The issue of “global warming” remains lodged in the nation’s collective consciousness, even in the midst of the most significant economic downturn in decades. After all, nobody *wants* the ice caps to melt and polar bears to drown. Nobody *wants* the doomsday predictions that spill across the covers of magazines to come true. But how do we know what proportion of our efforts and energy should go to carbon reduction versus reductions in poverty, crime, infant mortality, or other recognized social problems? How do we know how much carbon reduction is enough, or if we are even capable of preventing “global warming” by now reducing our carbon emissions? On a more personal level, how do we know if it is worth it to come home at the end of a cold Chicago day and kick that thermostat up to 70?

The regulatory and legal mechanisms used to alter a market – to change the equilibrium price or quantity – can also be used to simply provide information about that market. For example, enacting a law that forces a company to reduce carbon emissions by one ton can reveal the marginal cost of one ton of carbon reduction at a given level of emissions. But that law does not necessarily reveal the value of that very same reduction. However, a law suit brought against

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a company asking a court to force the company to reduce carbon emissions by one ton, on the basis that those emissions are dangerous, may well force a court to evaluate both the marginal cost of the reduction and its marginal value, and weigh those against each other. Legal and regulatory mechanisms can help reveal value because they are information-forcing.

The challenge, therefore, is to devise a regulatory mechanism capable of accurately determining the value of carbon reductions, so that the appropriate prices and quantity of carbon reductions can be established by a regulator. This is a multi-disciplinary task, requiring not only economists and lawyers, but also scientists, philosophers, doctors, and more. What we provide in this paper is a first step in identifying the right questions to ask, in the hopes that we can encourage people far wiser than ourselves to begin to answer them.

First, this paper will outline why pricing “clean” air (or as a proxy, reductions in carbon) is so difficult. We will examine the problems of valuing clean air as a good and discuss differing mechanisms designed to help with the price discovery process. In particular, this paper will discuss who should pay for carbon reductions – firms or individuals – and why the issue of intergenerational equity must be addressed in a carbon reduction regime. Next, this paper will explore the existing legal mechanisms that could be used to reduce carbon and address the limitations of these mechanisms with respect to determining the value of carbon reductions. We will explore why the legal mechanisms that are utilized to establish accurate prices for other goods appear to be less effective when applied to the price of carbon reduction. Finally, this paper will touch on the political economy issue of who should regulate reductions and how compliance can best be insured.

II. The Fundamental Pricing Problem in Achieving Clean Air

Pollution is a classic externality. The firm or individual creating the pollution does not pay for the damage to society unless a regulatory regime requires the firm to abate the pollution it causes. Historically, the externality was internalized through command and control regulation. The regulatory agency selected a specific permitted level of emissions and often established a specific technology that a firm had to use to satisfy the regulatory requirement. For example, the use of scrubbers on power plant smokestacks was the application of a specific technology to reduce emissions. Eventually, command and control regimes were criticized for their inefficiency. The reduction targets were often seen as arbitrary and subject to political influence. The use of a mandated reduction technology was seen as limiting firm creativity and increasing compliance costs. Firms often felt that they could adopt differing technologies across the range of their production process to meet the reduction goal without necessarily relying on the mandated technology. Over time regulatory emphasis shifted to more market oriented approaches. As demonstrated in figure 1, the cost of pollution (in this graph carbon) reduction varies depending on the method of reduction employed. When a command and control regime mandates a specific technology, that technology might not be the least-cost way for a firm to reduce pollution. The mandate affects incentives – taking away the incentive to use anything but the mandated technology – and therefore prevents firms from making profitable reductions.

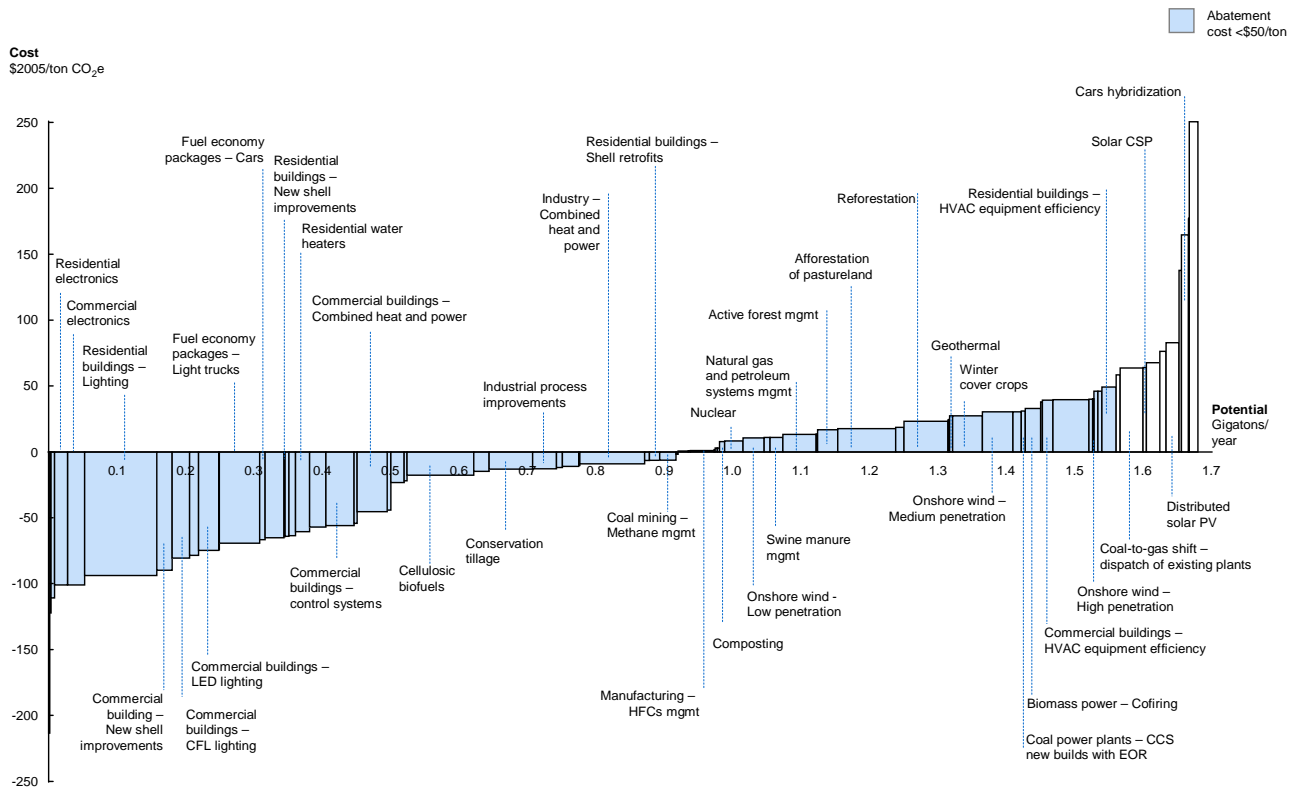
Currently, many laws in the United States addressing pollution employ some “market based” approaches to pollution reduction. Although the effectiveness of market mechanisms in environmental regulation is still debated, it is clear that in the United States the tendency over the

past few decades has been to move away from command and control regulation and towards market-based regulatory mechanisms. ⁱⁱ

Figure 1. 2020 US abatement curve without international offsets

2020 U.S. carbon abatement cost curve without offsets

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SOURCE: McKinsey analysis

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Source: McKinsey & Company and The Conference Board, “Reducing U.S. Green House Gas Emissions: How Much at What Cost?” U.S. Greenhouse Gas Abatement Mapping Initiative, Executive Report, December, 2007.

The arrival of market-based emission reduction programs did not end the story, especially when it comes to carbon reduction. The purpose of a market is to use a price discovery

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mechanism to establish the correct price for a good. In this case the good is a negative externality — dirty air. Capturing this externality and internalizing it has proven effective in some areas, but those areas tend to present less complicated and pervasive economic and environmental considerations than carbon reductions. To understand why carbon reductions present a challenge unlike any the United States has dealt with before, consider the experience with one of the first cap and trade systems focusing on acid rain reduction. This program was successful, and in an evaluation of compliance costs and allowance market performance, Ellerman et. al,ⁱⁱⁱ found that the cap and trade system created under Title IV of the 1990 Clean Air Act led to significant overcompliance (3.4 million units below the cap) with considerable evidence of reduced compliance costs from initial baseline estimates.

But while the Acid Rain program has been a success, it suggests some important differences that set it apart from a potential carbon emissions trading program. These differences suggest that the ability of a cap and trade system, or other market mechanism, to serve as a price-discovery mechanism will not be so straightforward when it comes to carbon reductions. The acid rain market was smaller, less complicated and more geographically contained, which made it easier to pinpoint the value of reductions. In the acid rain program there were 72 utility companies operating 445 individual generating facilities. In contrast, coal-fired utilities are estimated at only 11% of greenhouse gas emissions suggesting that the number of market participants will be much larger. This increased size and complexity will not only make monitoring actual reductions from any one source far more complex and costly, but it will also increase the amount of information that needs to be available for a market to work efficiently. In addition, the acid rain program was a domestic policy. Because climate change has global implications, and because carbon, once released into the environment, does not remain in the area

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of emission, for a market to accurately reflect the true value of carbon reduction on a global scale, a world-wide market and a world-wide governance structure will be necessary. This will complicate the operation of the program and increase the amount of information necessary to be processed by the market in order to reflect the true value of carbon reduction.

One of the reasons the acid rain program succeeded was not an intentional component of the design, and would therefore be difficult to duplicate. Because the estimated price of purchasing emissions credits was projected to be fairly high – \$250 to \$400 ton of SO₂ in the first phase of the program – utilities were aggressive at reducing emissions levels. Utilities were able to act aggressively and comply at a lower cost because of two factors, neither of which are present for carbon reductions. First, the cost of the most expensive compliance option – adding scrubbers to smokestacks – declined faster than expected as utilities took advantage of scale economies to reduce costs. Because carbon reductions must come from so many sectors of the economy, those economies of scale cannot be reliably predicted to exist. The second compliance strategy was switching to lower sulfur coal, which became quite economical when changes in transportation regulations made it more economical for Midwest utilities to acquire western coal. In 1995, the average cost of reductions from scrubbers was \$265/ton and from fuel switching was \$153/ton. Interestingly, some of the fuel switching strategy was unwound in subsequent years when the relatively low cost of emissions credits allowed utilities to meet compliance standards by bundling high sulfur coal with emissions credits. Carbon emissions are too widespread to be reduced by “switching” technology. Although there are potential alternative energy sources that electricity generators could switch to, unlike sulfur dioxide, nearly every activity humans engage in results in carbon emissions.

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Another characteristic of the Acid Rain Program that likely distinguishes it from any attempt to regulate Carbon in a similar way is that participants were able to meet the compliance goal without producing break-through technology. Establishing the value of carbon reduction will prove far more complicated than sulfur because, unless people are willing to make profound changes in the way they live and the amount they consume, meaningful reductions will require significant advancements in existing technology and the creation of new technology. Given the goal of the program is to meet an emissions standard in the most efficient manner, this is not terribly disconcerting, but many adherents to market programs favor their design because it is technology forcing. If Carbon reductions are not met with the widespread application of new technology, many proponents of these programs will be disappointed. In fact, much of the investment in technology in the Acid Rain Program (use of scrubbers) only occurred because utilities over-estimated the future cost of compliance and expected a significantly higher price for purchasing low-sulfur coal.

Finally, carbon reductions present a number of administrative difficulties that may distort the ability of the market to accurately reflect the value of carbon reductions. The acid rain program was based on accurate measurement of emissions levels from specific sources and utilized strong penalties for non-compliance. It is hard to imagine that such a system would be available in a Carbon program that would require worldwide participation to be effective. The acid rain program was also designed to meet a specific standard and then keep emissions at that level. In a carbon program the standard will need to be revised and renegotiated based on changing circumstances. This need to periodically rebenchmark the emissions standard would

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introduce considerable uncertainty into the program and might undermine a cap and trade system. The effect of acid rain was visible, and the scope of the problem narrower, than the current debate over carbon reductions. The nature of the problem in the acid rain market made it fairly easy for a market mechanism to reveal both values and costs of reductions, allowing the regulators to choose the appropriate level of emissions and to, in effect, get the price “right.”

The difficulty in relying on markets to establish the price of carbon reductions is demonstrated by the vastly different estimates of the price of carbon reductions. The variation in these estimates is related to the high degree of uncertainty about everything from the costs and benefits of reduction to the political will to maintain a long-run reduction strategy in the face of changing political and economic conditions. For example, the Obama administration has estimated that the cost of carbon credits in its proposed cap and trade market would be \$13 to \$14/ton. The program would aim to reduce emissions 14% below 2005 levels by 2020 and would cover roughly 4/5ths of all emissions (it excludes agriculture). However, when the Congressional Budget Office scored a similar bill last year, it estimated the credits to cost \$23/ton at the beginning of the program and rise to \$44/ton by 2018. The total cost of the allowances over the first decade would be \$902 billion which is more than \$256 billion above the Obama estimate.

These government cost estimates can be further contrasted with estimates by the Conference Board and McKinsey (“McKinsey”). McKinsey produced an extensive modeling exercise to illustrate the potential for reducing greenhouse gas emissions relying on tested and high-potential emerging technologies that cost under \$50/ton of carbon. In the model, US carbon emissions would be reduced by between 3.0 and 4.5 million gigatons by 2030 at marginal cost of

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\$50 per ton while maintaining comparable levels of consumer utility^{iv}. Importantly, the report found that achieving these savings would require strong stimuli and policy actions. “Without a forceful and coordinated set of actions, it is unlikely that even the most economically beneficial options would materialize at the magnitudes and costs estimated here.”^v This suggests that there are significant barriers to a well-functioning market for carbon reduction. Some of the reductions identified by McKinsey are profitable reductions even without regulation – yet they are not being made because the market is already significantly distorted.

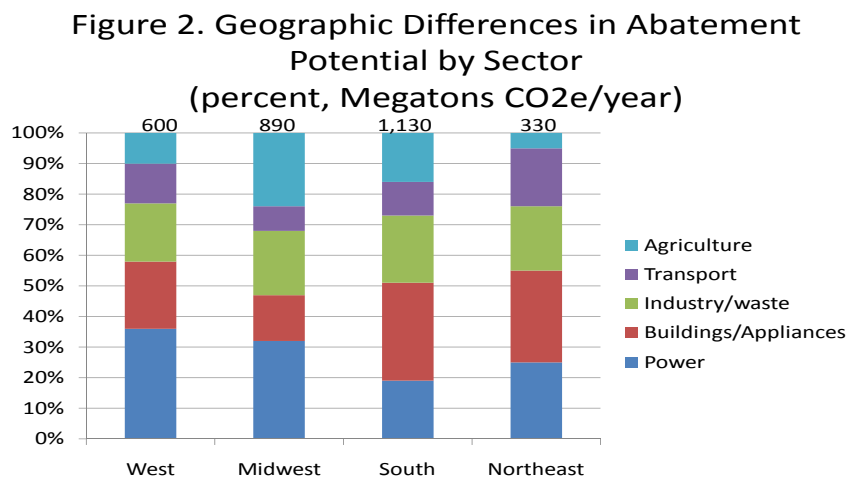
The clear opportunity the report finds is that almost 40 percent of the abatement can be done at “negative” marginal costs. What this means is that investing in these abatement options would produce positive returns over the lifecycle of the investment. The clear question is why are these profitable investments being under- utilized? The barriers include a mismatch between who pays for the cost of an abatement option versus who benefits (for example, the homebuilder may pay for the capital cost of the lower emissions while the benefit of the lower operating cost accrues to the homeowner) as well as a desire of consumers to want a rapid payback on any investment when up-front costs are required.

The report suggests a number of barriers and opportunities to reductions. A key barrier is the highly fragmented nature (in terms of the number of sources) of carbon released into the atmosphere. While abatement opportunities abound, there is no single source that can be targeted to meet reduction goals. The report estimates that the largest segment of potential abatement is represented by coal-fired power plants, which offer less than 11% of total abatement potential. Even the entire power generation sector only represents 33% of total

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reduction potential. This lack of a single obvious target will require a broader emissions reduction strategy than has been used for other more obvious point source pollutants.

A similar barrier is that abatement costs and potential vary widely across geographies. The report finds that while the abatement potential (at a cost of \$50 or less per ton) reaches 1,130 megatons in the South, the Northeast would only produce 330 megatons of abatement. For the Northeast to reach a higher level of reduction, the cost would have to rise significantly above the \$50 ton mark (Figure 2).



Capital costs represent another issue. The report estimates that the capital investment costs of capturing 3 gigatons of abatement would equal roughly \$50 billion annually through 2030 or \$1.1 trillion cumulatively. The investments would be highly concentrated in the power and transportation sectors and would likely put upward price pressure on electricity prices and vehicle costs. As with any capital investment, these opportunities would compete with other capital projects, making it likely that sustained investment would need to come from the public

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sector. Public investment designed to improve air quality while incidentally increasing energy and transportation costs may be hard to sustain politically.

A further problem with valuing carbon reductions is temporal. The cost of improving the air is necessarily front-loaded. The current generation must pay for a benefit that will largely accrue to future generations in terms of better health. The nature of emissions reductions is that you must pay now for future benefits. From a purely political economy perspective this requires the current generation to sacrifice some of its immediate welfare for the good of future generations, which requires self-sacrifice that may be difficult to achieve on a sustained basis. A recent example is the Governor of New York's decision to modify its participation in the 10 state Regional Greenhouse Gas Initiative in requiring reductions in power plant emissions.^{vi} Part of the rationale for that decision was the potential for higher costs of energy production in the state damaging an already weak economy. Industry representatives were also concerned that they had taken on long-term contracts for specific fuels that would make purchasing emissions credits very costly. Utility executives suggested that the number of "free" allowances be increased from 1.5 million tons to 6.5 million tons which at current auction prices would equate to a \$16.9 million savings. Given that emissions regulations are part of a political process, the uncertainty of whether a specific path of reductions will be sustained in the face of other political priorities adds an element of variability that makes longer term planning more complicated.

These are only some of the many challenges in pricing carbon reductions. The complicated, pervasive, and global nature of carbon emissions suggest that previously utilized market mechanisms will not work as seamlessly with carbon reductions. Next we consider

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whether existing legal and regulatory mechanisms are being productively used to assist in determining the value of carbon reductions.

III. Establishing the Value of Carbon Reductions

To understand the appropriate level at which to set carbon reductions, we first need to understand the ways in which individuals value carbon reductions. The question becomes, which regulatory mechanism best helps us determine the value of carbon reductions? Is it the information-forcing power of the lawsuit? Because of the political difficulties of aligning so many parties with different interests and different goals, will it require the power of a court, theoretically insulated from political pressures, to conduct the information-gathering expedition necessary to begin the weighing and measuring of the value of carbon reduction? As we consider the appropriate mechanism for identifying values, we should be attentive to the possibility that in our American system of governance, values identified through the legislative process, as opposed to the judicial process, may be perceived as more reflective of the values held by the average American. This consideration alone may migrate towards legislative, rather than court-driven, regulation of Carbon. This idea is reflected in the refusal by some courts to participate in the long-term regulation of global warming on the basis that such regulation constitutes a political question not suited to determination by a court. The legislative and executive are those branches of government directly accountable to the people, and therefore presumably those branches that would resolve questions of values most consistently with the values held by the people.

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The United States District Court for the Southern District of New York explained this position in the 2005 decision of *State of Connecticut v. American Electric Power Company, Inc.*^{vii} In *Connecticut v. American Electric*, eight states, the city of New York, and two private plaintiffs filed a law suit against several energy companies asking the court to abate the “public nuisance” of “global warming.” The Plaintiffs specifically sought an order requiring each Defendant to cap its CO₂ emissions and then reduce those emissions by some percentage each year for at least a decade. The Plaintiffs asserted that the Defendants, who were the five largest emitters of CO₂ in the U.S., collectively emitted about 650 million tons of CO₂ annually. Because this CO₂ contributed to global warming, the Defendants’ actions would allegedly cause irreparable harm to the Plaintiffs.

The Court acknowledged the actions that had, to that date, been undertaken by the executive and the legislative branches, such as the enactment of the Global Changes Research Act and the ratification of the United Nations Framework Convention on Climate Change. The Court also examined the analysis that it would be required to undertake should it grant the Plaintiffs the relief they requested. On balance, the Court concluded that “resolution of the issues presented here requires identification and balancing of economic, environmental, foreign policy, and national security interests” and therefore was a decision where non-judicial discretion was required. A comprehensive carbon reduction program is simply too vast and too complicated to be undertaken by a court. Furthermore, a court generally would not have sufficient expertise in the variety of scientific and technical challenges presented by a carbon reduction program to be able to fashion an appropriate remedy aimed at reducing carbon emissions.

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While a comprehensive program is clearly not feasible, judicial action is no more effective at determining the value of carbon reductions when it is more targeted. Although in an ideal world reductions would be valued at an individual level, that is simply not feasible. Arguably, every person has a unique carbon footprint based on their lifestyle and geographic location. An easy way to reduce carbon would be to require each individual to reduce their carbon footprint. This is already being tried in fledgling ways in the airline industry where it has been suggested that passengers should buy an offset as part of their ticket price to reflect the emissions the plane produces while they are flying to a given destination. This type of carbon user charge could be expanded to other activities such as a mileage charge for driving or other activities that would make the individual more aware of their carbon footprint. In theory as the cost of the carbon offsets rise, the individual would make choices to reduce their carbon emissions. There are obvious limitations to such an approach. For example, there is the tricky question of how to apportion emissions to individuals from a shared activity. For example, if an individual eats a meal at a restaurant should the emissions charge reflect the emissions life cycle costs of a specific entrée? If more carbon is produced in the production of a steak than a vegetarian entrée, should the carbon charge differ? This sort of user charge structure would require generating thousands of potential variations on prices to be intellectually honest.

While courts generally do not have the technical or scientific expertise of an agency such as EPA, they do have a certain amount of expertise in allocating costs. Environmental statutes such as CERCLA require courts to allocate the costs of environmental contamination using a variety of equitable factors. One of the factors that courts can consider is the economic value of the contamination to the polluting company. This suggests that courts could also allocate

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relative values of carbon reductions as well. But due to the nearly infinite number of differences in values, this task would be prohibitively time consuming.

These two ends of the spectrum – comprehensive court-driven carbon reduction and individual carbon valuation – do not seem feasible for judicial challenges. But the variations in between do not seem capable of evaluating carbon reductions either. One route towards addressing and valuing carbon reduction has been through targeted litigation and challenges to project-specific permitting requests. While the individuals and organizations bringing these actions may not characterize them as mechanisms to establish the value of carbon reduction, these actions can be evaluated for their ability to determine such a value. From the plaintiff's perspective, the end result of successful litigation is for the court to assess a value to the injury the plaintiff has incurred. In some cases, this injury can be calculated. In others, the injury is not quantifiable, or is so severe as to be monetarily uncompensable, and the only adequate remedy is for the court to order the defendant to specifically perform, or refrain from performing, a designated activity. The latter is generally the goal of the climate change litigant – to characterize the damages as so severe that the defendant is prevented from continuing the objectionable activity.

One example of such litigation is the *Connecticut v. American Electric* case described above. In that case, Plaintiffs did not ask the court to order Defendants to cease their carbon-emitting activity entirely. Perhaps this was an implicit recognition that to do so would be to ask the court to conclude that the value of carbon reduction is infinite – since such an order would shut down the five largest energy producers in the country. The Plaintiffs asked, rather, for the

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court to cap the Defendants' emissions (at a level to be determined by the court) and order those emissions to be reduced each year (by a percentage determined by the court).

Perhaps the most visible climate change litigation has been the Sierra Club's campaign against coal-fired power plants. The rationale for targeting coal-fired power plants is that coal-fired power plants emit more carbon dioxide per unit of electricity than any other fossil fuel.^{viii} The Sierra Club has made coal-fired power plants the face of global climate change, intimating that reduction in carbon emissions from coal-fired power plants is more valuable than any other source of emissions reduction. As the Sierra Club's website explains: "If the 100-plus coal-fired power plants currently proposed are built, the global warming pollution pumped into our air will make all our other efforts to reverse climate change irrelevant. Coal plants are the dirtiest, most regressive source of energy poisoning our communities and environment."^{ix} In short, the Sierra Club champions the shut down of coal-fired power plants at any costs; the value of carbon reduction from coal-fired power plants is apparently infinite.

This method of targeting a single source of power generation not only exacerbates the allocation problems raised above, it also undermines attempts to calculate the true value of carbon reduction. Reducing carbon emissions by shutting down coal-fired power plants has disparate impacts on geographical regions and income levels. Coal-fired energy production is largely located in the Midwest, where other sources of energy are not as readily available. The strategy of focusing on coal excludes any consideration of the possibility that reductions should come from somewhere else. Because the value of reducing carbon emissions from coal-fired power plants is essentially infinite under this model, the basic principle of these campaigns seems to be that shutting down coal fired power plants makes good sense regardless of the cost.

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This focus on shutting down a singular source of carbon ignores the important principle that a reduction of carbon is a reduction of carbon. Regardless of the source, the marginal value of a reduction in carbon is uniform at a given level. The cost, however, does vary by source.

Further complicating matters is that within the U.S. there is a clear geographic distribution of winners and losers. This variation by geography raises the question of whether a federal (or dare we imagine global?) mechanism for regulating carbon will accurately measure such profoundly varying values. In its broadest terms states in the middle of the nation would be most impacted given that they tend to have coal-based power generation and manufacturing industries with higher emissions levels. States on the coasts would fare much better. Table 1 shows the top 10 and bottom 10 states in terms of per capita emissions.

Table 1. Top 10 and Bottom 10 states in per capita greenhouse gas emissions in 2005

State	Per capita carbon emissions in tons	State	Per capita carbon emissions in tons
Wyoming	154.4	New Jersey	16.6
North Dakota	94.5	Florida	16.4
Alaska	73.5	Washington	16.0
West Virginia	73.1	Oregon	14.9
Montana	49.2	Massachusetts	14.0
Louisiana	45.6	Connecticut	13.4
Indiana	43.8	Vermont	13.1
Nebraska	41.8	California	12.8

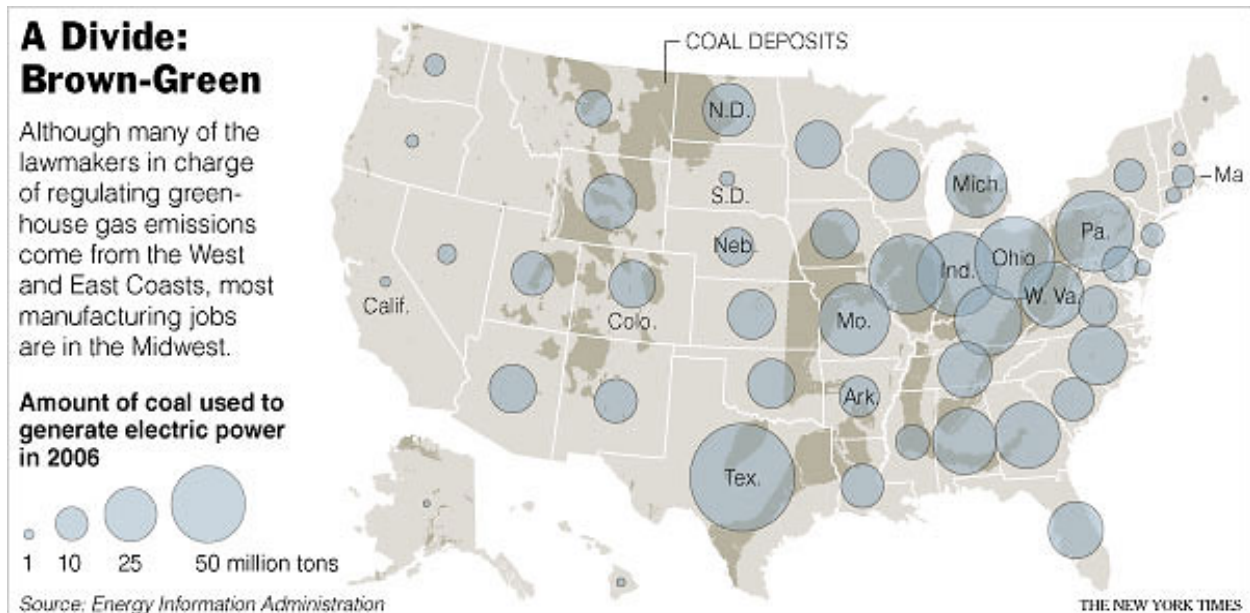
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Kentucky	41.7	New York	12.4
Iowa	39.7	Rhode Island	12.1

Source: Climate Analysis Indicators, World Resources Institute

This geographic divergence is even more apparent in the map below.

Figure 3.



The point is that this distribution of costs both across income and geography will also complicate the consistent adaptation of emissions reductions. While the “losers” in the new regime will press for compensation, it is unclear as to whether the winners will want to provide them with compensation. This issue is recognized in the proposed cap and trade market included in the Obama administration’s proposed budget. The budget includes a tax credit for low-income

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workers that would be \$400 for individuals and \$800 for families in part to offset the cost of the emissions program.

A similar route has been to challenge permit applications for new coal-fired power plants. Although these challenges generally seek the same outcome – shut down of a coal-fired power plant – the potential for this challenge to provide information necessary to establish the value of carbon reduction is much better. Regulatory agencies generally have more discretion to consider factors that might help create accurate pricing than courts would. For example, the Florida Public Service Commission is directed by statute to consider the following factors when determining the need for a new power plant:

. . . the need for electric system reliability and integrity, the need for adequate electricity at a reasonable cost, the need for fuel diversity and supply reliability, and whether the proposed plant is the most cost-effective alternative available. The Commission shall also expressly consider the conservation measures taken by or reasonably available to the applicant or its members which might mitigate the need for the proposed plant and other matters within its jurisdiction which it deems relevant.^x

To the extent that the Commission examines the impacts of carbon emissions on human health and the environment, this analysis could motivate both private and public inquiry into the potential damage caused by carbon emissions. This could provide information that assists in the calculation of the value of carbon reduction. And since permit decisions are usually made by state agencies, the strategy of challenging permits for new coal-fired power plants may also help incorporate some of the regional value differences into that pricing. It also allows the agency to factor in local cost information, by analyzing alternative methods of satisfying demand, such as increasing efficiency of electricity use.

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Several states have denied permits for coal-fired power plants on the basis that the contribution of carbon dioxide and other greenhouse gases to climate change threatens human health and the environment. One such denial occurred in the state of Florida, in the form of the denial of a determination of need for a new coal-fired power plant. The Florida Public Service Commission concluded that the utility could not prove that a proposed \$5.7 billion, 960-megawatt coal plant would be cheaper to build than investing in conservation, efficiency, and renewable energy sources. The Commission found that the utility “has failed to demonstrate that the proposed plants are the most cost-effective alternative available, taking into account the fixed costs that would be added to base rates for the construction of the plants, the uncertainty associated with future natural gas and coal prices, and the uncertainty associated with currently emerging energy policy decisions at the state and federal level.”^{xi}

A related political complication is the issue of distribution of benefits and costs. Regardless of whether the emissions reduction is done through a tax, a cap and trade market or traditional command and control regulation, it will impose a cost on society. Furthermore, research suggests that the cost is far from uniform. The Congressional Budget Office reports that to achieve a 15% carbon reduction would cost households in the bottom income quintile 3.3% of their after-tax income or roughly \$680 per year not including reductions in labor and output. The three middle income quintiles would pay between 2.7% and 2.9% of income (\$880 to \$1,500) while the richest quintile would pay only 1.7%. This is obviously regressive and suggests that some mechanism might be necessary to compensate the lowest income earners from the direct cost of the reduction.

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In the absence of a federal program addressing climate change, several states have taken steps to address carbon reductions.^{xii} Several states have established Climate action Commissions, which examine the possible consequences of climate change for a state and the costs and benefits associated with addressing them, and develop recommendations for appropriate policies. Other states have developed climate action plans, which identify the best way to address climate change given that state's specific circumstances.^{xiii} It is difficult to imagine that this assortment of state initiatives could result in an accurate estimate of the value of carbon reductions. However, these state initiatives may go a long way to identifying particular regional values for carbon reduction, and even more likely, may identify particular regional costs of carbon reduction.

Hawaii, Minnesota and California have established economy-wide emissions targets for their states. The earliest and most notable of these targets is California's AB 32, the Global Warming Solutions Act of 2006, requiring California to reduce its greenhouse gas emissions to 1990 levels by 2020. The California Air Resources Board ("CARB") has developed several strategies for meeting this reduction goal. The overall strategy includes direct regulations, alternative compliance mechanisms, monetary and non-monetary incentives, voluntary actions, market-based mechanisms such as a cap-and-trade system, and an AB 32 cost of implementation fee regulation to fund the program. This fee regulation charges sources of greenhouse gas emissions fees to support the administrative costs of the GHG reduction program. Under the draft regulations, CARB will calculate a Common Carbon Cost, which represents the cost per metric ton of carbon dioxide equivalent emitted by the source, to recover administrative costs associated with AB 32 programs.^{xiv}

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AB 32 is the type of state regulation that demonstrates the benefits of legislative or executive over judicial action. AB 32 creates a mechanism for valuing one of the ancillary costs of reducing carbon – the administrative cost. However, it is not clear how that information feeds back in to the California program – it does not appear to factor into the decision of how and where to set targets, instead calculating the relevant costs after the fact.

Some states have joined regional initiatives, which have begun developing systems to reduce carbon dioxide emissions from power plants, increase renewable energy generation, track renewable energy credits, and research and establish baselines for carbon sequestration. The earliest of these was the Regional Greenhouse Gas Initiative (“RGGI”), which was the first mandatory, market-based effort in the United States to reduce greenhouse gas emissions. Ten Northeastern and Mid-Atlantic states agreed to cap and then reduce CO₂ emissions from the power sector 10% by 2018.

As mentioned above, these agreements are subject to changed circumstances, and states may withdraw. To the extent that these associations are voluntary, they do not provide an accurate mechanism for valuing carbon reduction. However, they do provide some hints. For example, New York’s withdrawal from RGGI demonstrates that in that case, the cost was too high for the people of the state of New York. To the extent publicly elected officials participate in voluntary carbon markets, such as the Chicago Climate Exchange, withdrawal from participation in that program provides a signal that the value of a reduction in carbon to the public is less than the cost on that market.

In general, judicial responses to carbon reduction will not be targeted enough to prevent these regressive effects. It isn’t clear that legislative proposals have actually considered

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regressive effects. Interestingly, the geographic dispersion of costs and values may be precisely what prompts national legislation. States such as California, which relies very little on coal to generate electric power and has a long history of regulating air pollutants, have begun to enact their own state legislation committing to statewide reductions in carbon emissions. If these state actions successfully align the various interest groups such that national legislation is passed, there will presumably be an averaging of values and costs across the country.

IV. Governance: Is There a Regulatory Structure that Makes Sense?

Reducing carbon requires identifying a regulator to oversee reductions regardless of the mechanism that is chosen. Whether emissions are regulated by an emissions tax, cap and trade system, or under the Clean Air Act, the reductions must be measured and verified. Perhaps the toughest governance issue facing any US regulator is that the legal framework for air emissions (under the Clean Air Act) is designed to address pollutants that have regional and local effects. In contrast, carbon (and all the greenhouse gases) have global impacts requiring a regulatory/governance structure that addresses emissions regardless of where they are produced. Because of this, any regulatory structure must compliment that of other nations and recognize that a reduction program must take into account that carbon is emitted from many sources (industrial and transportation) in the economy and not just a handful of large sources. This suggests a comprehensive and integrated approach.

Whoever is the regulator will also have to establish some clear policy grounds on which to act. These grounds have likely already been provided by the EPA's finding that greenhouse gases pose a threat to human health and welfare. However, a clear tension will occur if the price of the reductions exceeds what society is willing to pay even in the face of the health dangers.

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This suggests a structure that permits those being regulated to take the lowest priced emissions reductions wherever they might be available. Hypothetically, a reduction in China may be far cheaper than a reduction in the US. In this case the regulator must be able to permit the regulated entity to meet the reduction by reducing carbon outside its jurisdiction while still being able to verify the reduction takes place.

(1) The Clean Air Act

In 2007 the United States Supreme Court in *Massachusetts v. EPA* concluded that greenhouse gases were “air pollutants” under the Clean Air Act and ordered EPA to determine whether greenhouse gases endanger public health or welfare. If EPA determined that greenhouse gases did endanger public health or welfare, which is referred to as an “endangerment finding,” then EPA would be required to regulate greenhouse gases under the Clean Air Act. On April 17, 2009 the United States Environmental Protection Agency issued a proposed finding that greenhouse gas emissions contribute to air pollution that may endanger public health or welfare. This proposal is the first step in the process of regulating greenhouse gases under the Clean Air Act.

Many environmental groups have applauded EPA’s finding as an important step in addressing climate change. Critics complain that the Clean Air Act is not well-suited to regulation of greenhouse gases, and that it will impose an inordinate burden on small business owners and low-level emitters. The Clean Air Act sets National Ambient Air Quality Standards (“NAAQS”) for air pollutants. States are required to develop plans (State Implementation Plans, or “SIPs”) to bring NAAQS down to prescribed levels and to keep them there. This form of reducing air pollutants is most effective when the source of the air pollutant and its presence in

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the environment are geographically proximate. If, for example, a state does not have control over the source of a pollutant, it may be impossible for that state to meet the NAAQS – even if it reduces emissions within the state to zero. Greenhouse gases, which travel long distances once they are released into the environment, would present an even more difficult challenge if there was a NAAQS. Carbon emitted in China could become part of the measured level in Utah. Carbon levels are global, so for one state to be in compliance, the entire world would have to be in compliance.

There are additional concerns with regulating carbon under the Clean Air Act, such as the point at which a modification of an existing source of air pollution would trigger the Clean Air Act's Prevention of Significant Deterioration ("PSD") standards for greenhouse gases. Depending on how EPA defines a "modification" a large number of sources could be covered by PSD and therefore be required to get permits to make any modifications.

One thing EPA does have is the experience and expertise in environmental regulation that Congress and the judiciary lack. Congress is affected by political pressure (which of course EPA is not immune to either) and lacks the technical expertise of EPA. The judiciary, while theoretically immune from political pressure, has essentially no technical expertise.

EPA Administrator Lisa Jackson has herself suggested that the more effective method for regulating greenhouse gases is through legislation specifically targeted at those emissions. The limits imposed by EPA on greenhouse gases could be very strict, which may encourage Congress to pass less onerous and more flexible legislation. The two most likely forms of legislation are discussed below as potential mechanisms for regulating greenhouse gases.

(2) Cap and Trade

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In 2000, the World Bank created the Prototype Carbon Fund. This fund was backed by 17 (mostly large, multi-national) companies and the governments of Canada, Finland, Japan, the Netherlands, Norway and Sweden and was designed to invest \$135 million in a variety of carbon abatement projects ranging from forest management in Romania to wind farms in China. For each ton of carbon dioxide abated, each participant received one carbon credit. In 2005 the European Union launched its carbon market which has received considerable attention. One estimate places the value of the carbon market worldwide at \$96 billion in 2008 and the assumption is that the introduction of a US market will cause the value to soar. Through October of 2008, the value of an index of carbon credits on the New York Stock Exchange increased at 5.4%.

However, market participants note that current carbon markets are very risky investments. As one consultant stated “These are political markets, and you can’t take the politics out”.^{xv} For a firm to make money in the market it must have a close understanding of the regulatory climate in differing nations. Managing this risk is quite complex given the role that regulatory policy may have on the value of the credits or the verification of what is an acceptable reduction needed to generate a credit. Strategies for creating credits range from the fairly simple (one firm creates credits based on deploying more efficient cookstoves in Uganda) to the complex where the credits are based on capturing industrial gases from chemical plants in China. The process of developing and certifying emissions credits is an expensive and time-consuming process. In some cases the value of the credit is over-estimated. For example credits based on land-fill gas reductions in the developing world are often over-valued. Citizens of less developed nations tend to throw out less trash than their western counterparts and even the composition of the trash

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is different meaning that the level of emissions was lower than expected. Even once the credits are developed they must be certified by a committee of the United Nations.

Proponents of emissions markets believe that much of what is being experienced is growing pains of a new market. The value is in the future potential in the market as it matures. One analyst suggests that much like valuing energy companies based on projects in the pipeline, emissions markets should be understood based on the ability to produce future credits. On this basis, one firm—EcoSecurities has 408 projects underway in 34 countries employing 18 differing technologies that could produce 118 million emissions credits by 2012.

Other than political and regulatory issues, the biggest driver of carbon market prices appears to be the price of natural gas and coal. For utilities one of the easiest ways to reduce emissions is to switch to natural gas from coal. If natural gas prices fall (as they have recently) fuel switching can drive down the price of emissions credits.

Finally a clear hurdle facing the market is that much of the current market is based on provisions in the Kyoto Protocol. The terms of Kyoto expire in 2012 and absent the renewal or expansion of the standards, this clearly adds uncertainty to the future value of credits.

Perhaps the final comment on the potential weakness of a cap and trade system is captured by New York Times columnist Thomas Friedman who writes, “Americans will be willing to pay for a tax for their children to be less threatened, breathe cleaner air and live in a more sustainable world with a stronger America. They are less likely to support a firm in London trading offsets from an electric bill in Boston with a derivatives firm in New York in order to help fund an aluminum smelter in Beijing, which is what cap and trade is all about. People won’t support what they can’t understand.”^{xvi}

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(3) Carbon Tax

In the same op-ed piece Friedman argues for a carbon tax. He suggests two primary objections are usually sited in regards to the tax. First, (while not insurmountable) a tax does not necessarily guarantee that a specific quantity of emission will be reduced. In its simplest form it does not set a cap on emissions it simply makes emissions more expensive. The second objection is that it is a tax. As with any tax it will clearly create costs on society and lead to economic dislocation. The same will occur under cap and trade programs but it is easier to obscure who is paying for emissions reductions under this more complicated set up.

The advantages to a carbon tax are transparency, ease of administration and establishing a clear price for emissions reductions that will allow for more accurate planning. An example of has been proposed by Congressman John Larson, chair of the House Democratic Caucus. It structure is to introduce a \$15 per metric ton tax on carbon dioxide that would increase by \$10 per year. The goal in the bill is to reduce emissions at 80 percent below 2005 levels by 2050. The bill has intermediary goals, which if not met, automatically increases the tax by \$5/ton. The bill would also place a tax on carbon-intensive imports. To make such a tax palatable, the revenue raised would largely be used to offset payroll taxes.

V. Conclusion

This paper has argued that any emissions reduction plan will work best if it is based on an established price that accurately measures the cost and benefits of emissions reductions. This would seem to be an obvious premise. However, what we suggest is that the political/economic structure for determining that price is a function of summing a set of costs that are largely

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determined by values. Under the current structure these values are not determined through a careful judicial or regulatory process (although this may change given the recent EPA ruling on greenhouse gases), but rather through a legislative process where the price that emerges is not necessarily related to either the costs or benefits of reduction.

Further, the creation of an artificial price may hurt both supporters and detractors of emissions reduction plans. Given that emissions reductions require a shift away from fossil fuels to new technologies and new behaviors, an incorrect price will make the path for technological change far more difficult. If the price makes the transition too costly, it is likely that the legislative process will undo the standard. If the price is too low, technology based adaptation may come very slowly if at all.

Finally it must be kept in mind that a successful program needs to be built off of a global platform. Absent such a governance structure we are likely to continue to see a fragmented effort at addressing global warming based on a series of differing standards, reduction mechanisms and underlying prices.

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Bibliography

Denny Ellerman, Richard Schmalensee, Paul L. Joskow, Juan Pablo Montero and Elizabeth M. Bailey, "Emissions Trading Under the U.S. Acid Rain Program: Evaluation of Compliance Costs and Allowance Market Performance", Center for Energy and Environmental Policy Research, Massachusetts Institute of Technology, 1996.

Schmalensee, Richard, "Greenhouse Policy Architecture and Institutions", MIT Joint Program on Science and Policy of Global Change Report 13, November 1996.

McKinsey & Company and The Conference Board, "Reducing U.S. Greenhouse Gas Emissions: How Much at What Cost?" U.S. Greenhouse Gas Abatement Mapping Initiative, Executive Report, December, 2007.

Marc Gunther, "Doing well by clearing the air", CNNMoney.com, November 3, 2008,

http://money.cnn.com/2008/10/31/magazines/fortune/gunter_carboncredits.fortune/index.htm

Thomas L. Friedman, "Show Us the Ball", New York Times, April 8, 2009,

<http://www.nytimes.com/2009/04/08/opinion/08friedman.html?scp=4&sq=thomas%20friedman&st=cse>

Danny Hakim, New York Times, March 6, 2009, "Patterson Shifts on Emissions, Drawing Fire",

http://www.nytimes.com/2009/03/06/nyregion/06paterson.html?_r=1&scp=2&sq=hakim%20emissions&st=cse

ⁱ The six recognized anthropogenic greenhouse gases are carbon dioxide, methane, nitrous oxide, sulfur hexafluoride, hydrofluorocarbons, and perfluorocarbons.

ⁱⁱ Moving to Markets in Environmental Regulation, J. Freeman and C. Kolstad eds., at 4

ⁱⁱⁱ A. Denny Ellerman, Richard Schmalensee, Paul L. Joskow, Juan Pablo Montero and Elizabeth M. Bailey, "Emissions Trading Under the U.S. Acid Rain Program: Evaluation of Compliance Costs and Allowance Market Performance", Center for Energy and Environmental Policy Research, Massachusetts Institute of Technology, 1996.

^{iv} McKinsey & Company and The Conference Board, "Reducing U.S. Greenhouse Gas Emissions: How Much at What Cost?" U.S. Greenhouse Gas Abatement Mapping Initiative, Executive Report, December, 2007. The report defines consumer utility as "functionality or usefulness for people, including level of comfort: in this context holding utility constant would

imply no change in thermostat settings, or appliance use; no downsizing of vehicles; homes or commercial space; traveling the same mileage annually relative to the levels assumed in the government base case.

^v Id. at xii.

^{vi} Danny Hakim, NYT 3/6/09 “Patterson Shifts on Emissions, Drawing Fire”

^{vii} State of Connecticut, et al., v. American Electric Power Co., Inc., et al., 406 F.Supp.2d 265 (S.D.N.Y. 2005).

^{viii} U.S. Department of Energy and U.S. Environmental Protection Agency, "Carbon Dioxide Emissions from the Generation of Electric Power in the United States." July 2000.

^{ix} <http://www.sierraclub.org/environmentallaw/coal/>

^x Section 403.519(3) Fla. Stat.

^{xi} Order No. PSC-07-0557-FOF-EI, issued July 2, 2007, in Docket No. 070098-EI, In re: Petition for determination of need for Glades Power Park Units 1 and 2 electrical power plants in Glades County, by Florida Power & Light Company.

^{xii} California, Hawaii, Wisconsin, Maine and Colorado are among those states. For a more complete listing, visit

http://www.pewclimate.org/what_s_being_done/in_the_states/state_legislation.cfm.

^{xiii} http://www.pewclimate.org/what_s_being_done/in_the_states/state_legislation.cfm

^{xiv} http://www.arb.ca.gov/cc/adminfee/draft_admin_fee_reg.pdf

^{xv} Marc Gunther, “Doing well by clearing the air”, CNNMoney.com, November 3, 2008, http://money.cnn.com/2008/10/31/magazines/fortune/gunter_carboncredits.fortune/index.htm

^{xvi} Thomas L. Friedman, “Show Us the Ball”, New York Times, April 8, 2009, <http://www.nytimes.com/2009/04/08/opinion/08friedman.html?scp=4&sq=thomas%20friedman&st=cse>