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A GUIDE TO THE CLEAN AIR ACT FOR THE RENEWABLE ENERGY COMMUNITY

by David R. Wooley[1]

Renewable energy is a clean energy source. However, air regulations have furnished limited benefits to renewable energy markets. Fortunately the opportunity to integrate renewables into the Clean Air Act is arriving now. By understanding how air regulation works, the renewable energy community can help shape effective policy, assure that renewables cut air pollution, and secure financial benefits.

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A Message from the Staff of the Renewable Energy Policy Project

People see renewable energy as an environmental technology. It cuts emissions, as well as the land and water impacts of conventional energy production. Yet even though renewables are a proven air pollution prevention technology, air pollution regulations usually do not incorporate renewables. This paper by David Wooley discusses the benefits of including renewables in emerging air pollution policy, and concludes that air regulators should incorporate renewables as a way to gradually reduce the air impact of electricity generation.

It is equally important for environmental advocates to include renewables in their campaigns. Currently U.S. clean air advocates quietly push for more combined-cycle natural gas plants nationwide. These plants are indeed an enormous improvement over old coal plants. However, one reason the push is a quiet one is that natural gas is not an overwhelmingly attractive clean air technology, particularly among the American public. So while clean air advocates believe they have a practical strategy to cut air pollution, they also face a marketing problem.

One way to arouse Americans to the problem of clean air is to highlight the devastating impacts of air pollution—asthmatic children, damaged forests, and acidic alpine lakes, among others. In the absence of an explicitly stated strategy in favor of natural gas, the default slogan becomes “Close down dirty coal plants” through environmental regulations.

Perhaps the greatest asset renewable energy holds for environmentalists is that it is something positive to offer as a solution. Asking Americans to favor renewable energy, in addition to opposing coal plants, reflects a diversified political and marketing strategy that can reach out to a wider audience. Because more people can choose products such as green power and solar panels, the two-pronged strategy reflects the need to offer not only regulatory solutions that appeal to politically-aware citizens, but also market-based solutions that resonate with concerned consumers who choose to vote with their wallet rather than call their local politician.

The renewable energy community can help environmentalists think about how to use renewable energy as a marketing tool. Renewable energy advocates and firms, by meeting with environmental activists, can inform them that renewables work and are increasingly affordable. They can also build confidence with environmentalists who may be uncomfortable partnering with private companies.

Partnerships work. Two REPP papers have highlighted the close cooperation between environmental groups and utilities offering “green power” in Minnesota and Colorado. The same model has spread to Oregon and Pennsylvania. Many more partnerships, with different levels of cooperation, promise to translate concern for the environment into expanded renewable energy markets. They also promise to expand the active constituency of citizens who will act to clean the air, both in the legislature and in the marketplace.

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by David R. Wooley[2]

EXECUTIVE SUMMARY

Our nation's heavy reliance on fossil fuels is a central obstacle to improving air quality and preventing catastrophic climate change. Clean, renewable energy resources—wind, solar, geothermal, biomass, and small hydro—are an attractive solution to this problem. The clean air benefits of renewable energy, however, generally go unrecognized by regulators, under-appreciated by consumers, and uncompensated by markets. A prime example of these problems is the fact that current air pollution control regulations do not allow renewables to participate fully in emissions trading applicable to the electric power sector.

Electric utilities are major culprits for several air quality problems. Utilities are responsible for 27% of nitrogen oxide emissions, two-thirds of sulfur dioxide emissions, and over a third of carbon emissions. As a result, they are a principle contributor to acid rain, smog, regional haze, mercury contamination, and global climate change. Renewable energy is a key alternative to conventional electricity generation. The development of renewables could be stimulated by changes to the Clean Air Act's cap-and-trade programs. As Congress revisits clean air issues over the next several years, renewable energy representatives could push for statutory changes that reward renewable energy for the air quality benefits it provides.

Cap-and-Trade Programs and Renewables

Cap-and-trade programs, though controversial within the environmental community, are becoming a dominant form of air pollution control. Understanding them will help the renewable energy community learn how to reap deserving financial benefits from air quality regulation. Cap-and-trade regulation begins with a limit on tons of pollutant (cap) that can be emitted in a given period and for a given region or sector. For the electric power sector, regulators then issue allowances (permissions to emit a ton of pollutant) to generators. There are many ways for regulators to issue allowances. These include auctions and generator-by-generator allocations based on applying a uniform emission rate (consistent with achieving the cap) to historical or projected generation (e.g. pounds/megawatt hour). An individual generator can choose to comply by limiting its emissions to the amount equal to its given allowances. It could also choose to emit less than the amount allowed, and sell off unused allowances to generators that need them—generators that do not hold enough allowances for their planned amount of emissions. Thus, cleaner generators reap financial rewards, and dirtier generators must pay a price for their higher emissions. The amount of money each allowance represents, and therefore the total financial reward for cleaner generators depends upon the demand for allowances, and the ability of generators to furnish spare allowances.

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With changes in federal/state regulations, renewable energy facilities could receive allowances—a source of supplemental project revenues—in several ways. First, renewables could earn allowances based on the electricity they generate at the same rate as fossil-based electric power generators (i.e., so many allowances per megawatt-hour of production). Second, renewables could earn allowances based on an estimate of the pollution they actually avoid. (For example, photovoltaic systems can receive credit for avoiding pollution from "peaking" power plants with high emission rates that operate only during summer demand peaks.) Third, the regulator can set aside allowances for renewables as a percentage of total allowances offered to utilities.

The U.S. Environmental Protection Agency selected the last option, set-asides, in the first national emissions trading program, which tackled the acid rain problem. While the overall trading program succeeded in incorporating pollution control costs into electricity prices, the set-aside scheme failed to be an effective means of encouraging renewable energy.

Yet precedents set and lessons learned from that program can be used to structure future cap-and-trade programs so that they offer meaningful revenue opportunities for renewables. First, the value of allowances in the overall program was low, as utilities found inexpensive ways to reduce emissions. Thus, they did not have to scramble for extra allowances offered by the set-aside scheme. To compound the problem of low demand, the set-aside scheme offered allowances to renewable energy projects at a low rate per unit of energy produced—one allowance for every 500 megawatt-hours generated. Another difficulty was that the program offered allowances only to utilities, and not independent power producers who installed many renewable energy facilities. Finally, the statutory basis for the program did not anticipate electricity restructuring, since it contained conditions unique to a heavily regulated electricity sector.

Promising Financial Benefits

Based on projections of renewable energy generation in 2010 and using conservative estimates of allowance trading prices for multiple pollutants, this analysis estimates that a properly formulated cap and trade program

Annual Value of Pollution Allowance Trading to the Renewable Energy Industry in 2010

Industry	**20-MW Facility**	**Entire Industry (in millions)**
Wind	$360,517	$311
Biomass	587,059	467
Geothermal	946,109	447
Solar	119,181	46
Total		$1,271

could produce the following annual financial benefits for renewable energy industries:

Clearly the renewable energy industry has much to gain from securing and participating in a properly structured emissions trading program for the electric power sector. By 2010, the renewable energy industry could earn over $1.3 billion from sales of air pollution allowances, allocated to the industry by air quality regulators. Conversely, the industry has a lot to lose from defective cap-and-trade programs. A poorly constructed emissions trading program can actually deprive renewables industry of its ability to claim that energy production from wind, solar, biomass and geothermal reduces air pollution, while simultaneously making compliance easier for conventional power plants. This would weaken the environmental/ consumer appeal of “green power.”

Future Cap and Trade Programs

Several cap-and-trade programs are currently in the works. East of the Mississippi, an emerging NO_x trading program could include set-asides for renewables. In fact, several states have already set aside allowances, including Massachusetts, New Jersey, and New York. Ideally, regulators (typically state governments) should reserve up to 10-15% of allowances intended for utilities to renewables and energy efficiency.

Another cap-and-trade program could arise to control particulate matter and to reduce regional haze in national parks throughout the U.S. Finally, carbon dioxide trading could arise under the Kyoto Protocol on climate change. Though it faces determined political opposition, C02 controls, if properly structured could emerge as an important basis for emission trading revenues for renewable industry.

Recommendations

To achieve these objectives renewables industries could consider: forming coalitions (among themselves and with environmental groups); drafting legislative and rulemaking language; and, developing more detailed analyses of policy prescriptions and associated economic and environmental benefits.

This paper recommends the following actions to air regulators and legislators if they are considering ways to accord benefits to renewable energy.

- Encourage state efforts to adopt renewable set-asides in state and regional emissions trading programs to control ground-level ozone, attain particulate matter standards, and improve visibility in national parks.
- Reduce the sulfur dioxide cap to the level needed to full protect human health and sensitive ecosystems and, in a second step, reduce the cap again to reflect objectives for renewable energy development. The cap could be implemented through a generation performance standard with a direct allocation of allowances to renewables, or set-aside of allowances for renewables. Alternatively, Congress could fix the SO_2 cap-and-trade system to cure the limitations on who can earn credits and should extend the period in which credits can be earned.
- Replace pollutant-by-pollutant emission credit systems with a multi-pollutant trading paradigm that merges allocation, verification, and tracking systems for all pollutants in order to reduce administration and transaction costs.

- Ensure that any CO_2 emissions trading scheme contains a cap that is tight enough to stimulate markets for renewable energy resources (either domestic or international) and that, in setting emission caps, lowers the tonnage allowed from fossil fuel generators by an amount based on projected electric power generation from renewables.
- Make renewables eligible to earn early reduction credits in any U.S. early reduction credit bill.
- Create a specific allowance allocation award or set-aside for renewables in any full-blown carbon cap-and-trade system.
- Encourage EPA to establish pilot programs with cooperating states that combine implementation of NO_x trading programs with any voluntary state climate change programs.
- Experiment with assigning emission allowances for aggregations of small and distributed renewable energy resources with a pre-approval process to provide project applicants with more certainty about the incentives to be awarded.

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The elegance and popularity of renewable energy resources stem in large part from their "green" qualities. Wind, solar, and geothermal energy can provide light, heat, air conditioning, hot water, and transportation with little damage to air, water, and land resources. And while biomass energy resources are not pollution-free, they emit little or no sulfur dioxide (SO_2) and, when managed conscientiously, may produce no net greenhouse gases. The nitrogen oxide and particulate matter emissions from new biomass sources are no worse than, and are sometimes better than, well-controlled fossil-fired energy sources. Given the right incentives and market rules, reliance on renewable energy resources could increase dramatically in the next 20 years, which could have substantial air quality benefits. Currently, however, markets often ignore the public benefits of renewable energy, and regulators generally do not recognize the potential of these energy sources as a low-cost emission control strategy.

Renewable energy resources will not gain a sustainable foothold until energy markets fully recognize, value, and compensate these sources for air quality and other social benefits. One step toward this is to modify air pollution control regulations to allow renewables to participate fully in emissions trading applicable to the electric power sector. As a result of recent federal court decisions, it is increasingly likely that Congress will revisit clean air issues. When it does, renewable energy representatives could push for statutory changes that reward wind, solar, and biomass generators for the air quality benefits they provide. The air quality policy instruments described in this paper can be used in combination with other policies, including renewable portfolio standards, public benefit funds, and net metering, to advance renewables.

PART I. THE CLEAN AIR ACT AND RENEWABLES

Air Pollution Associated with Electricity Generation

The production of electricity from fossil fuels—coal, oil, and, to a lesser extent, natural gas—exacts a growing toll on human health and our environment.[3] Most people in the United States do not associate electricity use with air pollution. But our light switches, air conditioner controls, and production lines are linked to the largest sources of acid rain, smog, regional haze, and climate change pollutants in the country.[4] (See Table 1.)

- *Acid Rain:* Power plant emissions of sulfur dioxide and nitrogen oxides (NO_x) react in the atmosphere to form compounds that are transported long distances and cause acidification in lakes, streams, and soils; nutrient saturation of coastal waters and river basins; crop damage; forest decline; and loss of biodiversity. Power plants are responsible for 64% of SO_2 emissions and 27% of NO_x emissions in the United States.

- *Photochemical Smog:* Power plant NO_x emissions react with volatile organic compounds (such as gasoline vapors or solvents) in sunlight to produce ground-level ozone, or "smog". This can cause lung damage and exacerbate asthma and emphysema. Increased emergency room visits for respiratory causes have been linked with exposure to ozone. Children active outdoors in the summer, when ozone levels are higher, are the most susceptible.

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[3] This report focuses on interactions between renewable energy resources and air pollution control in the electricity sector. Although renewables could well become a strategy for reducing emissions in the transportation sector (through quotas for non-fossil fuels for vehicles, for example, or cross-sector trading of emission reduction obligations), such policy instruments are beyond the scope of this paper.

[4] These impacts are in addition to air, water, and land impacts due to fossil fuel production and transport occurring "upstream" of combustion in steam electric generating stations. For more information on acid rain, visit the U.S. Environmental Protection Agency (EPA) at <www.epa.gov/acidrain>. Also see Curtis Moore, *Dying Needlessly: Sickness and Death Due to Energy-Related Air Pollution*, REPP Issue Brief No. 6 (Washington, DC: February 1997).

- *Regional Haze:* The pollutants from fossil fuel combustion also degrade visibility in national parks. Very small sulfate and nitrate particles (less than a few microns in diameter) scatter and absorb light in the atmosphere, creating hazy conditions in parks from the Grand Canyon to Acadia Park in Maine. The particles also cause lung disease.

- *Mercury Contamination:* Power plants are responsible for nearly one-fourth of total U.S. emissions of mercury, a neurotoxin that accumulates in human tissue and causes serious human neurological impairment. Humans are exposed primarily through repeated consumption of fish that accumulate mercury compounds from a contaminated food chain.

- *Climate Change:* Electricity generation produces one-third of U.S. emissions of carbon dioxide (CO_2), an important greenhouse gas that traps heat near the ground to destabilize the climate.

Table 1. Sources of Air Pollution in the United States, 1997

Pollutant	Source	Emissions (thousand tons and share of national emissions)
Nitrogen oxides	Electric utilities	6,178 (27%)
	Other commercial, residential, and industrial sources	5,463 (24%)
	Transportation	11,595 (50%)
Sulfur dioxide	Electric utilities	13,082 (64%)
	Other commercial, residential, and industrial sources	5,896 (29%)
	Transportation	1,380 (7%)
Carbon	Electric utilities	583,400 (36%)
	Other commercial, residential, and industrial sources	523,300 (32%)
	Transportation	523,700 (32%)

Source: NO_x and SO_2 data based on U.S. Environmental Protection Agency, *National Air Quality Trends Report 1997*, EPA 454/R-98-016 (Washington, DC: December 1998); carbon data based on U.S. Department of Energy, Energy Information Administration, *Annual Energy Outlook 1999*, DOE/EIA-0383(99) (Washington, DC: December 1998), p. 192.

Renewable Energy: A Clean Energy Resource

In recent years, the technological readiness and market availability of renewable energy have advanced to the point where renewable energy can be developed at a scale that makes it a viable emissions reduction tool. A 1997 study by a group of clean energy advocacy groups estimated the impacts of adopting a comprehensive set of policies to reduce U.S. carbon emission 10% below 1990 levels by 2010. The researchers found that non-hydro renewables could supply 14% of U.S. electricity use by 2010 and 40% by 2030 when combined with aggressive energy efficiency investments. (Electricity use was 17% lower than "business as usual" by 2010 and 52% lower by 2030.)[5]

These increases in renewable energy production would have dramatic air quality benefits. Wind farms and photovoltaic energy create little or no air pollutant emissions. And geothermal and bioenergy plant developers cite very low emission levels in comparison to coal, oil, and even clean-burning natural gas. The 1997 study mentioned above found that the combination of renewable energy and energy efficiency in 2010 reduces annual SO_2 emissions by 78%, NO_x emissions by 48%, and particulates by 36%.

Numerous studies suggest that the use of renewable energy resources can expand rapidly.[6] Two studies by the U.S. Department of Energy considered the potential increase in generation of these sources if Congress were to ratify the Kyoto Protocol on climate change. (See Table 2.)

Table 2. Current U.S. Renewable Energy Generation and Projections under Kyoto Emission Targets

Source	1996	2010
	(billion kilowatt-hours and projected share of total U.S. electricity generation)	
Geothermal	15.70	47–110 (1.3–3.2%)
Wood and Biomas[a]	46.67	82 (0.81%)
Photovoltaics	0.82	6–10 (0.18–0.29%)
Wind	3.17	28–81 (0.82–2.4%)
Total	**66.36**	**163–283[b]**

[a] Combines generating capability from electric generators and cogenerators.

[b] Since the figures for 2010 come from two sources, the total renewable energy generation in 2010 is not compared to total U.S. electricity generation.

Source: Scenarios in 2010 for wind, photovoltaics, and geothermal based on Interlaboratory Working Group on Energy-Efficient and Low-Carbon Technologies, *Scenarios of U.S. Carbon Reductions: Potential Impacts of Energy Technologies by 2010 and Beyond* (The Five Labs study) (Washington, DC: U.S. Department of Energy, 1998). The scenario is based on a "high-efficiency/low-carbon" projection, in which the nation meets its Kyoto Protocol commitments based on domestic measures, including "a major effort to reduce carbon emissions through federal policies and programs (including environmental regulatory reform), strengthened state programs, and very active private sector involvement." 1996 data and 2010 projection for biomass based on U.S. EIA, *Impacts of the Kyoto Protocol on U.S. Energy Markets and Economic Activity* (Washington, DC: 1998), specifically a scenario in which carbon emissions are cut by 7% below 1990 levels in 2010.

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[5] Alliance to Save Energy, American Council for an Energy-Efficient Economy, Natural Resources Defense Council, Tellus Institute, and Union of Concerned Scientists, *Energy Innovations: A Prosperous Path to A Clean Environment* (Washington, DC: 1998), p. v.

[6] Shell International Petroleum Company estimates that renewable energy could contribute as much as two-thirds of the energy currently supplied by fossil fuels; see <www.shell.com/about/content/0,1369,1503-3080,00.html>. The Presidential Council of Advisors on Science and Technology (PCAST), *Federal Energy Research and Development for the Challenges of the 21st Century* (Washington, DC: November 1997). According to the U.S. Energy Information Administration, through 2020 U.S. renewables consumption will increase at a 0.8% rate. The National Energy Strategy calls for a doubling of non-hydro renewables capacity by 2010, to 25,000 MW. U.S. EIA, *Country Analysis Brief* (Washington, DC: November 1999). See <www.eia.doe.gov/emeu/cabs/usa.html>.

CLEAN AIR OPPORTUNITIES AND RISKS FOR RENEWABLES

The current structure of the Clean Air Act (CAA) not only fails to promote renewables, it can actually hurt them substantially. The industry is at serious risk of losing its ability to claim that renewables improve air quality. Under some forms of cap-and-trade systems (described later), the addition of new renewable generation will have no effect on the total amount of pollution emitted. By entering the debate on the "next Clean Air Act" and by selective involvement in key Environmental Protection Agency (EPA) and state rule-making cases, the renewables industry could influence the structure of emissions trading programs and retain one of the most persuasive arguments for developing wind, solar, biomass, and geothermal energy resources.
Moreover, the Clean Air Act can be modified so that renewable energy developers receive revenue for the air quality benefits they provide. For instance, legislators and regulators could modify emission cap-and-trade systems to carve out a distinct role for renewables in emission allowance trading. The potential rewards, in the form of increased project revenue, are large (as documented later), particularly if a mechanism is developed to address the multi-pollutant reduction values of renewables.

Changes to the Clean Air Act also present a good opportunity to push for other forms of renewable energy incentives, including a national renewable portfolio standard, federal funding for capital cost buy-downs, emission taxes, net metering, or production tax credits.[7] These policy reforms have been included in tax and electric utility restructuring bills, but could just as well emerge in Clean Air Act amendments. The next congressional debate on clean air will undoubtedly focus on pollution from the energy sector. The renewables industry therefore needs a basic understanding of air pollution regulation in order to position itself to achieve energy policy reforms in the next Clean Air Act.

PART II. AN INTRODUCTION TO THE CLEAN AIR ACT

The Clean Air Act is a work in progress. The implementation of the amendments passed in 1990 is expected to take 20 years or more. During this period there will be several opportunities for administrative action by EPA to build renewable energy resources into air quality planning. More important, recent court decisions that have either struck down or stayed EPA regulatory actions mean that there is a distinct possibility that Congress will amend the act again early in this decade and that the amendments could include renewable energy incentives.[8]

This part of the report describes briefly the history of the CAA as it relates to renewable energy resources and the electricity industry. Also included is a brief explanation of emission cap-and-trade systems. The 1990 CAA amendments strongly encourage the use of cap-and-trade instruments to control air pollution. The most prominent of these are the national acid rain control program (addressing SO_2 emissions) and emerging regional cap-and-trade systems (addressing NO_x emissions). These programs could be modified to encourage development of renewables. Additional emissions trading programs being developed that could include

[7] See, e.g., Union of Concerned Scientists, *A Powerful Opportunity, Making Renewable Electricity the Standard* (Cambridge, MA: 1999) (describing the renewable portfolio Standard), at <www.ucsusa.org>; Nancy Rader and Ryan Wiser, *Strategies for Supporting Wind Energy: A Review and Analysis of State Policy Options*, National Wind Coordinating Committee, 1999, at <www.nationalwind.org/pubs/default.htm>. Late in 1999, Congress extended (for 2.5 years) the production tax credit for wind energy and some forms of biomass. Amendments to the Clean Air Act may well be under consideration as we approach the next tax credit expiration date.

[8] A May 1999 decision of the U.S. Court of Appeals (American Trucking Assn. v. EPA, 175 F.3rd 1027 (D.C. Cir. 1999) struck down EPA's 1997 National Ambient Air Quality Standards. The decision could cripple key provisions of the Clean Air Act. A second decision, also in May 1999, stayed EPA's program to reduce interstate pollution transport involving ground-level ozone pollution in the Eastern United States (State of Michigan, et al., v. USEPA, Order of U.S. Court of Appeals for the D.C. Cir., May 14, 1999). If these decisions are not reversed, Congress will be under pressure to amend the Act.

tradable emission reduction credits for renewables are also identified.

Brief History of the Clean Air Act

The Clean Air Act of 1970 ("the Act") was the first substantive and comprehensive environmental statute enacted by Congress.[9] The Act underwent a major revision in 1977 as a result of congressional impatience with the pace of air quality improvement. For a variety of reasons, the 1977 amendments also proved ineffective against several air pollution problems that became especially prominent and controversial early in the 1980s. Public concerns over acid rain, regional smog, and air toxics increased as efforts to amend the law continued from 1982 to 1990. The CAA took its current form on November 15, 1990.

The central pillars of the 1990 amendments are:

- Title I: seeks to prevent smog and attain national air quality standards;
- Title II: imposes tighter tailpipe and fuel standards for vehicles;
- Title III: focuses on protecting human health from air toxics (pollutants that have serious health effects, such as cancer, birth defects, immediate death, or catastrophic accidents);[10]
- Title IV: seeks to control acid rain;
- Title V: creates a new comprehensive permitting system; and
- Title VI: protects the stratospheric ozone layer and monitors greenhouse gases.

The parts of the Act that matter most for renewables are those that cut emissions from electric power generation and provide a framework within which incentives for renewables can be added: Titles I, III, and IV. The 1990 amendments rely heavily on market-based control methods and pollution prevention strategies. All key titles of the amended law require or allow some form of emissions trading, marketable permit programs, emissions fees, or early reduction credits. These amendments ignited a regulatory explosion. EPA must set emission standards for 90 separate air toxic compounds, cut power plant SO_2 emissions by 40%, bring 100 urban areas into compliance with air quality standards for ground-level ozone, lower tailpipe emissions dramatically, and require completely reformulate motor vehicle fuels.

Aggressive as it was, however, the amended act is deficient in several areas and needs to be strengthened further. This is especially true for persistent air pollution problems associated with the electric utility industry. The sulfur dioxide emission reductions in the 1990 amendments, though important, will not suffice to prevent acid rain.[11] Utilities remain largely exempt from regulations on air toxics. The United States continues to experience widespread violation of health-based standard for ozone and fine particles.

The 1990 amendments also failed to address two increasingly prominent global air pollution problems. First, aside from emission inventory and monitoring requirements, the Act does not address greenhouse gas

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[9] For more on the Clean Air Act's history, see Murray Tabb, "Twenty-Five Years of the Clean Air Act in Perspective," Natural Resources and the Environment (American Bar Association), Fall 1995, pp. 13–20.

[10] For a list of toxic air pollutants, visit EPA's Unified Air Toxics Website at <www.epa.gov/ttn/uatw/>.

[11] Canadian environmental ministry officials, industry, and environmental organizations found that an additional 75% reduction in U.S. and Canadian SO_2 emissions is needed to protect sensitive lakes; Acidifying Emissions Task Group, National Air Issues Coordinating Committee of the Canadian Environmental and Energy Ministers, *Towards a National Acid Rain Strategy* (: 1997). U.S. agencies have found that a large percentage of freshwater lakes in the Adirondacks will be lost without additional SO_2 emission reductions; National Acid Precipitation Assessment Program, *Biennial Report to Congress: An Integrated Assessment* (Washington, DC: May 1998).

emissions directly. Carbon dioxide is the most important of these emissions and, as noted earlier, electric power plants emit one-third of total U.S. CO_2 emissions.[12] Second, mercury pollution from coal combustion is becoming a crucial regional and global issue due to contamination of essential food supplies. Thus despite the 1990 Clean Air Act, electricity production continues to be a principal cause of atmospheric pollution and health damages.

How Does the Clean Air Act Work?

Air Quality Standards and State Implementation Plans

The National Ambient Air Quality Standards (NAAQS) have been a cornerstone of the Act since 1970. Set by EPA, the NAAQS limit the allowable concentrations of six specific "criteria pollutants" in the outdoor air. Table 3 describes the six pollutants[13] for which NAAQS have been set and their principal environmental and health effects. (See Table 3)

To implement the NAAQS, state air agencies develop State Implementation Plans (SIPs) containing a variety of emission controls to reduce pollution. Typical control measures include stack-gas cleaning devices for power plants and factories, inspection and maintenance requirements for motor vehicles, and changes in motor vehicle fuel composition. States usually have a great deal of discretion in choosing among strategies to achieve the NAAQS. The plans are submitted to EPA for approval.

If EPA approves the SIP, its emission control strategies are incorporated into "permits" issued for all major air pollution sources.[14] Almost all electric utility generators are major sources. If the EPA rejects the SIP, which rarely happens, and the state does not submit a satisfactorily revised SIP, EPA then develops its own air quality plan for the state (including emission control strategies and permits).

Visibility protection is accomplished by a similar process. EPA sets goals for eliminating haze in national parks, and states develop and implement plans to achieve those goals.[15]

If a new source of air pollution is built or an existing source is modified in a way that increases emissions, the operators must obtain a "new source" permit that ensures the new emissions will not degrade clean air areas or interfere with plans to "attain" the NAAQS in regions that violate EPA's standards ("nonattainment areas"). New and modified sources must control emissions through the use of "best available control technology" or "lowest achievable emission rate," depending on location.[16]

Direct Federal Controls

In several instances, the federal government has power to impose emission controls directly, independent of the states. This can take several forms:

- *Acid Rain*: Congress did not entrust this issue to EPA and the states, and in 1990 imposed plant-

[12] The Kyoto Protocol on climate change would also impose control on five other greenhouse gases in addition to CO_2—methane, sulfur hexaflouride, perflourocarbons, nitrous oxide, and hydroflourocarbons. Visit The United Nations Environment Programme's website at http://www.unep.ch/iuc/ for more information on the Protocol.

[13] These are often referred to as the "criteria pollutants" because Congress required EPA to issue a comprehensive criteria document describing emission sources, effects, and control technologies for the pollutants.

[14] "Major" sources typically emit 100 tons per year of any pollutant (though it is even lower in nonattainment areas and for air toxics such as mercury).

[15] EPA regulates visibility primarily under Section 169A of the CAA, which provides special authority to improve visibility in national parks.

[16] New and modified sources in non-attainment areas must offset their emissions by purchasing emission reduction credits from existing sources that agree to reduce emissions by an amount greater than emissions from new sources. It is conceivable that the new-source offset programs could be modified to allow new air pollution sources to obtain credits by supporting or purchasing credits from renewable energy sources. For several reasons, however, this is unlikely to offer a significant or widespread financial advantage for renewables. Markets for offsets are often limited geographically and temporally.

TABLE 3. THE SIX CRITERIA POLLUTANTS

CRITERIA POLLUTANT	MAJOR SOURCES	HEALTH IMPACTS AND ENVIRONMENTAL DAMAGE	OTHER IMPORTANT CONSIDERATIONS
SULFUR DIOXIDE	65% from power plants; produced by combustion of sulfur-bearing fuels (e.g., coal, oil) and smelter ore	Causes asthma attacks at high concentrations; Causes acid rain	Precursor to particulate matter
NITROGEN DIOXIDE	29% as a combustion product from power plants	Damages soil and water bodies due to eutrophication and nitrogen saturation; Causes acid rain	Precursor to ground-level ozone and fine particulate matter
OZONE	At ground level, formed when NO_x reacts with volatile organic compounds in the presence of sunlight	Strong lung irritant, associated with decreases in lung function, lung tissue damage, chronic lung and heart diseases; Damages crops and forests;	Main component of "photochemical smog"
PARTICULATE MATTER (PM) FINER THAN 10 OR 2.5 MICRONS IN DIAMETER	Emitted directly by Power plants, and formed in atmosphere from sulfur and nitrogen oxide emissions	Strongly associated with chronic lung and heart disease; Causes regional haze conditions, damaging visibility in national parks	Like ground-level ozone, PM can cause damage hundreds or thousands of miles beyond point of emission, due to long-range transport on prevailing wind and weather patterns
CARBON MONOXIDE	Released principally by cars and trucks	Deadly at high concentrations; Displaces oxygen in blood at levels found in many urban centers	Largely a problem of central city areas
LEAD	Emitted by lead smelters and garbage incinerators, and, in trace amounts, during coal combustion	Neurotoxin, deadly in high doses; Impairs brain development in children; Inhibits proper development of fetuses	Total lead emissions dropped 96% from 1970 to 1987due to elimination of leaded gasoline

by-plant SO_2 emission limits (expressed as tons/year) on hundreds of electric generators and allowed use of a "cap-and-trade" system to comply with the limits.

- *Air Toxics*: EPA is directed to set national emission performance standards for 189 ultra-toxic substances, applicable to several hundred named categories of industrial air pollution sources (such as chemical plants and refineries). Electric utilities were exempted, at least for the time being, from these "Maximum Achievable Control Technology"emission limits.
- *Interstate Air Pollution*: EPA is authorized to impose tighter controls (either by calling for SIP revisions or by imposing controls directly) to prevent emissions in one state from interfering with the ability of another state to attain air quality consistent with the NAAQS.
- *"Mobile" Source & Fuel Standards:* According to congressional formulas and guidelines, EPA sets tailpipe emission standards for cars and trucks and reformulation standards for gasoline and diesel fuel.

Finally, any discussion of "who's in charge" is not complete without a reminder that Congress or the federal courts may intervene and change emission control requirements.

PART III. EMISSIONS TRADING UNDER THE CLEAN AIR ACT

What does all this have to do with renewables? Not much at the moment—but the CAA is potentially the foundation on which to build a multibillion-dollar revenue stream for renewable energy firms. Part of that foundation is in place: Congress has both specifically and generally recognized the air pollution control potential of wind, solar, and biomass technologies in existing and emerging emissions trading programs.[17]

The 1990 CAA amendments contain many provisions that require or encourage use of emissions trading or other forms of economic instruments to control air pollution.[18] These programs seek to increase economic efficiency by giving regulated industries greater flexibility to comply with anti-pollution regulations. Through emissions trading options, overall emission control costs are lowered by encouraging the largest reductions to occur at facilities that can reduce pollution at the lowest cost.

Emissions trading provisions remain controversial within the environmental community. Some groups, such as numerous environmental justice groups and the Sierra Club,[19] object to trading since it can create local pollution "hotspots"—where emissions and human health impacts remain high due to sources that comply by purchasing emissions allowances from cleaner sources elsewhere. Such hotspots can disproportionately affect

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[17] The Acid Rain title contains the most direct endorsement of renewable energy resources: "It is also the purpose of this subchapter to encourage energy conservation, use of renewable and clean alternative technologies and pollution prevention as a long range strategy...for reducing air pollution and other adverse impacts of energy production and use." §401(b), 42 U.S.C. § 7651(b).

[18] The most prominent trading mechanisms are in the acid rain title of the 1990 Amendments. More generally, §110(a)(2) encourages states to include "economic incentives such as fees, marketable permits and auctions of emission rights" as part of their state implementation plans to attain air quality standards; 42 USC §§7410(a)(2); 7502(c)(6); and 7602. The ozone nonattainment provisions of §182(g)(4) require state Economic Incentive Programs for control of mobile and stationary sources of air pollution; 42 USC § 7511a(g)(4). The stratospheric ozone program relies heavily on an international cap-and-trade scheme for pollutants that degrade the stratospheric ozone layer; §§607, 616; 42 USC §§7671f, §7671o. The Act also makes heavy use of emissions trading to control motor vehicle and fuel emissions.

[19] In February 1999, the Sierra Club Board of Directors adopted a resolution opposing emissions trading. The policy does, however, also contain an extensive list of conditions that the Club would place on any pollution trading program and a list of impacts to be avoided. See <www.sierraclub.org/policy/conservation/trading.asp>.

low-income and minority communities. Without taking a position in this debate, it is worth noting that if trading programs exist or are on the drawing board, they need to have an explicit role for renewables.

Cap-and-Trade Systems

Emissions trading mechanisms can take many different forms, but most are based on the "cap-and-trade" concept and contain common structural elements.

What is an emission cap? Most emissions trading mechanisms are based on a "cap," expressed as a limit on tons of pollutant that can be emitted in a given period. Typically, caps (or emission budgets) limit emissions in tons per year or, in the case of summertime smog pollutants, tons per season. Caps are set based on a judgment (often by political leaders) about the level of emissions that can be tolerated without adverse effects on health or the environment.

Emission caps may be specific to geographic areas or even to industries. For example, a global CO_2 control strategies may contain emission caps applicable to each nation. National CO_2 caps may be implemented through separate caps applicable to utility, commercial, and mobile source pollution sectors. As described later, the cap on eastern U.S. NO_x emissions has 22 separate state caps, which may ultimately be translated into industry-specific caps (such as seasonal tonnage limits on NO_x emissions from electric power plants).

A properly set emission cap generally increases the costs of higher polluting producers and gives cleaner sources a competitive boost. For example, in the electric power sector, the national cap on SO_2 emissions increased costs for coal-fired electric generation without affecting generators using natural gas (a non-sulfur-bearing fuel).[20] A national or global CO_2 cap would narrow the gap between the costs of conventional fossil-fuel-based electric power and renewable energy resources. For this reason, emission caps are generally favorable for renewables industries.

By itself, however, the creation of a cap-and-trade system does not necessarily benefit renewable energy industries. If the difference between the cost of production of conventional generation and renewables is too great, then the cap may only serve to encourage the relatively cleaner but nonrenewable forms of production (such as natural gas over coal). In such cases, supplemental forms of incentives and other governmental support for renewable energy resources may be needed. As described later, allocating allowances directly to renewables or creating a "set-aside" of allowances for renewables are two ways to ensure that a cap-and-trade system encourages development of renewable energy effectively.

What currency is used in a cap-and-trade system? Environmental regulators often grant permission to emit under an emission cap in the form of "allowances." These are distributed to or earned by the affected emission sources on an annual basis. An allowance usually represents permission to emit one ton of the pollutant per year (or season). For example, the state environmental agency may allow a power plant in New York to emit 1,000 tons of NO_x each summer season. At the end of the season, the source must demonstrate that it has not emitted more than this amount. Alternatively, the source could emit fewer tons than the number of allowance it holds and sell its "surplus" allowances to other emission source operators, who comply with the cap using a combination of allocated and purchased allowances. The revenues from the sale of "excess" allow-

20 The program did, however, discriminate against new sources by requiring them to purchase allowances from existing polluters. See T. Woolf, B. Biewald, and D. White, *Electricity Market Distortions Associated With Inconsistent Air Quality Regulations*, prepared for The Project for a Sustainable FERC Energy Policy, November 18, 1999; at <www.synapse-energy.com>.

ances helps the seller recoup some of the costs of achieving the better-than-required level of emissions.

How are allowances distributed among affected sources? Once the cap is set, there must be an "allocation" mechanism to decide each source's emission control obligation. Regulators can allocate the allowances directly or they can auction the allowances to all regulated facilities. In the latter case, renewables projects would not participate in the auction if they do not emit, but they could engage in trading if allowances were "set aside" for them, as described later. (An alternative method of awarding pollution control value to renewables in a cap-and-trade system is to auction the allowances and use the revenues to pay for incentives to renewable energy developers.)

In the CAA acid rain provisions, Congress specified the number of SO_2 allowances that each electric power plant source would receive, based roughly on a uniform emission rate (1.2 lbs/mmBtu) applied to the plant's historic (annual) electric power production. In other systems, the states make the allocation decision, often in a rule-making procedure preceded by a massive negotiation session among the interested industries. To date, renewable energy advocates have not participated in these negotiations. Distributing allowances based solely on historical emissions can hurt new renewable energy projects that did not exist during the period selected as the basis of historical emissions.

An alternative to relying on historical emissions is to assign a certain number of allowances for each unit of actual heat input or electricity production ("output") going forward ("earn as you burn" or "forward looking").

The choice between input- and output-based allocation is also a key design decision. An input-based allocation gives allowances to sources based on emissions per unit of boiler heat input (measured in Btus). Many environmental groups strongly prefer an output-based allocation since it provides greater incentives to reduce emissions through plant operational efficiency. For example, under a forward-looking, output-based allocation method, CO_2 emissions could be allocated to all fossil and renewable power plants on the basis of X allowances for each megawatt-hour of actual electric power production. A regulatory structure that imposes a uniform emissions limit on generators based on a set ratio of mass emissions to electric production (lbs/mWh) is sometimes referred to as a generation performance standard (GPS).[21]

How will a purchaser verify the allowances offered for sale? Every cap-and-trade system must have a mechanism to record initial allocations and trades among affected parties, plus an effective system to monitor compliance. In the acid rain program, Congress assigned this job to EPA, which has constructed an elaborate electronic system to record trades, so that purchasers can be assured that traded allowances can be used for compliance purposes.

How do buyers and sellers of allowances find each other? Congress set up several mechanisms in the acid rain program to ensure that a robust market in allowance trading would occur. It required EPA to hold periodic allowance auctions to help define market prices and to give affected industries an easy place to find transaction partners. Private market exchanges and brokerage associations soon emerged, however.[22]

How does a renewable energy resource with no emissions end up with allowances to sell? This is the key question, since if renewable industries are not active in the development of emissions trading programs, they will not be allocated any allowances and the pollu-

[21] For an example of a GPS proposal, see S. 689, *Electric System Public Benefits Protection Act of 1997*, introduced by Senator Jeffords (May 1, 1997). A GPS can be coupled with a variety of different allowance allocation methods.

[22] The Emissions Marketing Association Web site at <www.emissions.org> offers an online member directory and links to allowance trading exchanges and EPA Web sites. It has published an *Emissions Trading Handbook* available at <www.etei.org>.

tion control effects of their technologies may go uncompensated. Air regulators are not used to thinking of renewable energy resources as a pollution control strategy, so renewable energy representatives need to lobby actively for direct allocation or set-aside for renewables.

There are at least three ways to allocate emission allowances to renewables. The first method awards them on the same basis as other electric generation resources. For example, a regulator may set a cap on total emissions of NO_x from the non-nuclear and non-hydro electric generators, and then allocate allowances to new and existing generators by dividing the cap by the total amount of expected generation (for example, a certain number of allowances would be awarded for each megawatt-hour of electricity produced).[23] The result is that each unit of generation from a renewable resource would earn the same number of allowances as an equivalent amount of electrical output from fossil fuel generators. Allowances earned by renewables would be sold in allowance trading markets.

The second way is to assign an avoided emission value for each unit of electric power produced or avoided by clean technology. In other words, a regulator (primarily as a way to evaluate the effect of the policy mechanism) might decide to award allowances to a wind generator based on an estimate of the amount of pollution from conventional electric generation that would have occurred if the wind turbine did not exist. In most cases, the electric power generation displaced by renewables is associated with fossil-fired units that are "on the margin" (generating units that are able to increase or decrease electric power output in response to changing patterns of electric power supply and demand). Thus the emissions avoided by clean electric power technologies are not the average emissions resulting from all conventional generation, but rather the emissions from a subset of generators that are displaced.

This method can be problematic, however, since avoided emissions may be difficult to calculate. Emissions from conventional utility generators vary greatly by geographic region (low in the hydro-dominated Northwest and in the natural-gas-dominated Northeast, but high in the coal-dominated Midwest), by season, or even by time of day.

A third way renewables may gain emission allowances is through a set-aside. In the acid rain program, Congress set aside allowances for renewable energy and energy efficiency measures directly in the statute. In other cases, however, a renewables set-aside in an allowance allocation will occur administratively, often at the state level. For example, in the recent program to cut summer-time NO_x emissions, renewable advocates convinced EPA to develop a "model" trading program, encouraging states to set aside a portion of the total allowances to renewables and energy efficiency. Under this rule, states have discretion on whether to give allowances to renewables, and several have done so. But in many states there is little prospect of this happening, given the political power of the fossil fuel industry and the natural inclination of coal-based utilities to obtain as many allowances as possible.

How much are the allowances worth to the renewables industry, and are they worth enough to justify the costs of going after them? The value of an individual allowance will be determined by the market demand for allowances and the cost of emission controls. If the cap is set too high and if compliance is relatively easy to achieve with low-cost emission controls, then the market price for allowances will be low, since few emission sources will need to buy them in order to comply. In contrast, a tighter cap and costly emission control technology options will stimulate higher allowance prices.

If the cap is set properly, economic theory would predict the price of allowances to be comparable to the marginal

[23] Nuclear and hydro should be excluded due to the differences in type of environmental impact associated with such resources.

cost per ton of reducing emissions with fuel switching or emission control technology. Experience under the CAA acid rain program confirms a consistent relationship between allowance trading price and marginal costs of reducing emissions. Caution should be exercised, however, in regard to emission allowance price predictions. Historic projections of control costs and market values for allowances have been extremely inaccurate. Actual values for SO_2 allowances under the Title IV acid rain program up to 1996 were only 16–23% of conservative predictions made at the time of their adoption.[24] With these uncertainties in mind, a later section provides a range of possible market values for emission allowances, with an estimate of the financial benefits of a renewable allowance allocation to sample renewable energy facilities.

Renewables' Past Experience: The SO_2 Cap-and-Trade Program

A driving force behind the passage of the 1990 Clean Air Act amendments was the highly charged issue of acid rain. The interstate and international dimensions of the issue popularized awareness that air pollution is not just a local problem, nor simply a matter of preventing harm to humans from acute exposure. Ecosystems, scenic beauty, wildlife, and human health each suffer from chronic, low-level, and subcontinental scale exposure to sulfur and nitrogen compounds. In the most severe cases, acidity has killed entire fish populations in lakes and streams.

Title IV of the amended Act establishes a nationwide cap on SO_2 emissions and a pioneering emissions trading program. The program requires a permanent 10-million-ton reduction in annual SO_2 emissions below 1980 levels by 2010.[25] When fully implemented, Phase II of the program will limit total U.S. annual sulfur dioxide emissions to 8.9 million tons. The acid rain provisions have already achieved much of this reduction, along with a 2-million-ton-per-year reduction in utility NO_x emissions.

These acid rain provisions were a historic achievement, one not diminished by the fact that the emission reductions were not nearly deep enough to protect human health and the environment from acid gas emissions. The emission trading program for S02 emissions has worked well and and succeeded in incorporating pollution control costs into electricity prices.

The law permits power plant operators to trade SO_2 emission allowances. Allowances were trading at roughly $210 during the summer of 1999.

The acid rain program also includes a direct financial incentive to encourage utilities to reduce SO_2 emissions through energy conservation and renewables. By investing in these, utilities could earn special emission allowance awards that could be used to meet SO_2 compliance obligations or be sold at a profit to other utilities. This incentive for renewables is of historical importance only, however, since the program did not achieve any significant benefit for the renewables industry and has now expired. Understanding why the program fell short of its goals may be important to the design of a more effective future program for SO_2 and other pollutants.

Under §404(f)(g), EPA established a Conservation and Renewable Energy Reserve (CRER) that contained 300,000 SO_2 allowances.[26] The allowances were set

[24] See Dallas Burtraw, *Cost Savings Sans Allowance Trades? Evaluating the SO_2 Emissions Trading Program to Date*. Discussion Paper 95-30-REV (Washington, DC: Resources for the Future, February 1996). Visit RFF at <www.rff.org>.

[25] §§ 401-416; 42 U.S.C. §§ 7651-7651o. The first phase, effective January 1, 1995, required 110 power plants to reduce their SO_2 emissions to a level equivalent to an emission rate of 2.5 pounds of SO_2 per million Btu (SO_2 lbs./mmBtu) times an average of their 1985–87 fuel use (defined as annual average quantity of mmBTUs consumed). The Phase II reductions, effective January 1, 2000, require a significantly greater number of plants to reduce their emissions to a level equivalent to an emission rate of 1.2 SO_2 lbs./mmBTU times the average of their 1985–87 fuel use. The full affect of acid rain controls on SO_2 emissions will be achieved in 2010, when a series of power plant exemptions and extensions expire.

[26] 58 Fed. Reg. 3,590, 3,695 (1993); 40 C.F.R. part 73, subpart F. If allowances remain in the reserve after January 1, 2010, EPA must allocate them back to affected power plants on a pro rata basis.

aside from the emissions cap imposed on power plants. Allowances were awarded for SO_2 emissions avoided through energy conservation, biomass (including landfill gas), solar, geothermal, and wind energy projects implemented between 1992 and 1999. Renewable energy's minimum share of the CRER was a set-aside of 60,000 allowances. An allowance could be earned for every 500 megawatt-hours of energy produced by a qualified utility through renewable energy generation measures.[27] If fully used, over time the CRER would have displaced 885 million pounds of SO_2. Unhappily, this will never occur. As of June 1999, less than 12% of the 300,000 allowances had been allocated (about 36,000 allowances). Of this, only about 6,700 allowances went to renewable energy projects.

There are several reasons for the CRER's disappointing performance. The program was designed primarily to encourage early reductions (to occur before the statutory deadlines) and not as a long-term incentive for renewables. In addition, most utilities did not draw from the CRER by developing or purchasing power from renewable projects since they were easily able to meet their emissions limits with low-sulfur coal and other, more conventional means. Since cost of compliance was low, so was the price of allowances. This was a blow to the CRER, especially in light of the unreasonably low conversion rate (i.e., one allowance per 500 MWh) by which renewables and energy efficiency could earn sulfur credits.

The CRER also contained harmful restrictions on how to earn allowances from the reserve. For example, only utilities could earn allowances. They were required to engage in least-cost planning[28] processes in the acquisition of new generation sources and to adopt an unpopular income neutrality element in their rate structure to prevent revenue erosion from investments in energy efficiency. These concepts were cutting edge in 1990, but quickly became largely obsolete with the restructuring of the industry. Restructuring has forced divestiture of generation, loss of retail monopolies, and associated cost-cutting pressures. In short, the participants in the debate over the 1990 Amendments failed to anticipate electricity industry restructuring. As a result Congress conditioned the eligibility for CRER credits on requirements that were increasing impossible to meet under a restructured industry.[29]

If Congress is interested in correcting these defects, it could make several changes. In particular, Congress could:

- tighten the cap for the next phase of the SO_2 program
- allow non-utilities to earn SO_2 credits from the set-aside,
- extend the life of the special allowance pool and the period in which in which credits can be earned,
- eliminate the income neutrality and integrated resource planning eligibility requirements, and
- increase the rate at which renewable generators can earn credits to a higher allowance/mWh ratio.

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[27] 40 CFR Part 73, subpart F, A(3). See EPA, "Conservation Verification Protocols: A Guidance Document for Electric Utilities Affected by the Acid Rain Program of the Clean Air Act of 1990," EPA 430/8/B-92-002 (March 1993). Under this protocol, kilowatt-hour savings are translated into SO_2 tons by multiplying the energy savings by a rate of 0.4 lbs. SO_2/million Btu (about 2 allowances per GWh). This rate was intentionally set significantly below the average SO_2 emission rate for Phase I and Phase II units. The same rate is applied to renewable energy generation. As described in the act, this is 0.004 lbs./kWh; see 42 U.S.C. §7651c(f)(2)(F).

[28] "Least-cost planning," or integrated resource planning, was a concept adopted by state public utility commissions that required utilities to compare the cost of new plants with alternatives, such as energy efficiency.

[29] Utilities cannot earn allowances for renewable energy projects undertaken after January 1, 2000. EPA's CRER Web site is <www.epa.gov/ardpublc/acidrain/crer/crerpg.html>. The "income neutrality" policy does, however, retain importance in regulation of rates for monopoly electric distribution and transmission services .

An even better approach, however, could be to change the whole program in favor of an acid gas generation performance standard, with a direct allocation of SO_2 credits to renewable generation (see discussion above on "Cap and Trade Systems").

Emissions Trading: A Significant Source of Revenue

In light of the disappointing results of the CRER program, why should the renewable energy community care to put resources into the fight for future allowances? The answer lies in the financial consequences if Congress set a cap that was tight enough to force alternatives to fossil generation and awarded tradable emission allowances directly for electric power generation from renewable energy projects.

To examine this scenario, let's look at the number of allowances that might be awarded to renewables under a trading mechanism based on actual generation (either through a GPS or through a set-aside).[30] In this case, assume an allocation method in which renewables (like other generators) would earn allowances based on the

Table 4. Value of Avoiding Emissions by Renewable Energy Generation

Pollutant	Emissions Allowance Value (dollars/Ton)	Tons Avoided per MWh of Renewable Energy	Emissions Reduction Value (dollars/MWh)
CO_2 (low-cost allowance)	5	0.6	3
CO_2 (medium-cost allowance)	20	0.6	12
CO_2 (high-cost allowance)	60	0.6	36
NO_x	2,000	0.00075	1.5
SO_2	200	0.006	1.2
Total value with low carbon allowance			***5.7***
Total value with medium carbon allowance			***14.7***
Total value with high carbon allowance			***38.7***

[30] Estimates for CO_2 are based on the average CO_2 emissions/MWh associated with fossil fuel electricity generation in the United States, discounted by one-quarter to reflect the likely effect of a CO_2 cap on retirement of older coal-fired generation capacity. (An allocation based on today's generation and emissions would be about 0.8lbs/mWh.) We assumed fossil fuel only generation estimates since, as noted earlier, allocation to nuclear and hydro facilities is unlikely to receive support. NO_x estimates are based on the likely allocation of allowances under EPA's NO_x SIP Call in the eastern United States. This is a conservative figure since cuts in response to the SIP Call will not begin until 2003, and will apply only in the five summer months ("ozone season"). The SO_2 allowance allocation rate is based on that used to assign emission allowances to fossil generation under Phase II of the Clean Air Act acid rain program. This program begins in 2000, but will not be fully effective until 2010.

following estimates of tons of pollutant avoided for each megawatt-hour of electric output: 0.6 tons of CO_2, 0.00075 tons of NO_x, and 0.006 tons of SO_2.

Table 4 combines these allowance allocation rates with possible values for emissions allowances. It assumes fixed values of $2,000 per ton of NO_x and $200 per ton of SO_2, and considers the impact of three values for CO_2 allowances: $5, $20, and $60 per ton. This analysis includes three values since pegging a CO_2 allowance value is highly speculative, and demands a range of values to reflect uncertainty.

Multiplying the hypothetical allowance allocation (in allowances/unit of generation) by the expected value of the emissions allowances yields estimates of the value of emissions trading to the renewables industry in dollars/MWh of energy production. (See Table 5.) This can be applied to estimate the financial benefit of four renewable energy technologies industry-wide and of a sample facility. (See Table 6.)[31]

Table 5. Value of Combined Allowances to the Renewable Energy Industry in 2010

Technology	Electricity Generation (billion kWh, using midpoint from ranges in Table 2)	Emission Reduction Value (dollars/kWh, from Table 4)	Total Annual Value (million dollars)
Biomass	82	0.0057	467
Geothermal[a]	78.5	0.0057	447
Photovoltaics	8	0.0057	46
Wind	54.5	0.0057	311
All Renewable Energy	**223**	**----**	**1,271**

[a] The U.S. Department of Energy states that a geothermal power plant (type unspecified) emits 0.16 kilograms of SO_2 per MWh, or 0.00016 tons per MWh. If applied to the final dollar value per MWh estimated in Table 4 ($5.7/MWh), including this emission factor would reduce the dollar value by 0.63 percent (to $5.66/MWh). The small difference in values is not included in Tables 5 and 6.

[31] The figures in Table 5 and 6 represent gross revenues, and should be discounted by transaction costs (i.e., what it would cost a firm to obtain and to sell allowances).

At an emissions trading value of $5 per ton for CO_2 (the low allowance value considered), a properly constructed multipollutant cap-and-trade system would generate nearly $1.3 billion a year in revenue for the renewables industries. These values represent the product of the total energy generated in 2010 by each renewable energy technology and the value in dollars per kilowatt-hour for the various pollutants.[32]

Individual renewable energy facilities would have much to gain from participation in an emissions trading program. Using the allowance allocation rates for renewable energy generation estimated earlier, Table 6 estimates the annual revenue benefit to facilities of a cap-and-trade system that allocates NO_x, SO_2, and CO_2 emission allowances to renewable energy facilities in the same amounts as are currently allocated to fossil generators.

To estimate total generation for each facility, the table assumes installed capacity at 20 MW for each technology. To estimate the power generated by each plant, the table assumes the plants have capacity factors (the annual average percentage of maximum plant capacity actually used) as estimated in projections for 2010 for each technology by the Electric Power Research Institute and the U.S. Department of Energy.

Low-value CO_2 allowances ($5 per ton) combined with NO_x and SO_2 allowances could thus earn the following for renewable energy facilities:

- A 20-MW wind farm could earn about $360,000 a year from the sale of multipollutant emission allowances allocated. For purposes of comparison, this is equivalent to 13-14% of the cost of energy produced by a typical 20-MW wind farm.[33] The revenue enhancement from a cap-and-trade mechanism limited to NO_x and SO_2 would be about $171,000 a year.[34]
- A 20-MW biomass power plant would earn annual revenues of some $587,000 from a trading scheme for NO_x, SO_2 , and carbon dioxide. It would earn about $168,000 without including carbon dioxide.
- A 20-megawatt geothermal plant would earn annual revenues of $946,000 for all three pollutants, and almost $450,000 without carbon dioxide.
- A 20-megawatt solar facility, or 20 megawatts of aggregated PV systems, would earn annual revenues of almost $120,000 for all three pollutants, and of more than $94,000 without carbon dioxide.

It is important to note that a biopower operation will release no net carbon to the atmosphere only if the biomass comes from a supplier who manages stock so that planted biomass stores carbon equivalent to that released by the biomass burned. Since this condition is not directly related to combustion, it is not yet clear how air regulators can account for the full fuel cycle of biomass—from planting, harvesting, transport, and combustion—in a trading program.

Possible Impacts of a Trading Scheme on Renewables

Properly constructed, a cap-and-trade system could provide a powerful financial incentive for renewables. A poorly designed system, however, can have the opposite effect. To illustrate, consider the following situations.

[32] Where Table 2 offers a range of values, we use the median here.

[33] The National Wind Coordinating Committee (NWCC) estimates the cost of energy from a typical 50-MW wind farm to be 4.3¢/kWh; NWCC, *Wind Energy Costs*, Wind Energy Issue Brief No. 11, January 1997, at <www.nationalwind.org/pubs>.

[34] The values in Table 6 are based on the EIA projections in Table 2 of electricity generation from renewables under a aggressive U.S. climate change policy, multiplied by the “emission reduction value” figures in Table 5 for SO_2, NO_x, and CO_2.

Table 6. Annual Revenue for Renewable Energy Facilities[A]

Pollutant	20-MW Wind Facility	20-MW Biomass Facility[B]	20-MW Geothermal Facility	20-MW Solar Facility
CO_2 (low-cost allowance)	189,746	419,328	497,952	104,832
CO_2 (medium-cost allowance)	758,984	1,677,312	1,991,808	419,328
CO_2 (high-cost allowance)	2,276,951	5,031,936	5,975,424	1,257,984
NO_x	94,873	0	248,976	52,416
SO_2	75,898	167,731	199,181	41,933
Total with low carbon allowance	*360,517*	*587,059*	*946,109*	*119,181*
Total with medium carbon allowance	*929,755*	*1,845,043*	*2,439,965*	*513,677*
Total with high carbon allowance	*2,447,722*	*5,199,667*	*6,423,581*	*1,352,333*
Total for NO_x and SO_2 only	*170,771*	*167,731*	*448,157*	*94,349*

[a] Assumes a 36.2% capacity factor for wind and a Class 4 wind resource (a 20-MW wind facility produces 63.2 million kWh annually); a 20% capacity factor for residential C-Si PV in average insolation (20-MW of solar, in this case aggregated PV installations,ies would produce 35 million kWh annually); a 95% capacity factor for geothermal "flashed-steam" technology (a 20-MW geothermal plant produces 166 million kWh annually); and an 80% capacity factor for direct-fired biomass in 2010 (a 20-MW biomass plant produces 139.8 million kWh annually).

[b] It is assumed here that a biomass plant will emit enough NO_x to cancel out its value for that pollutant. However, advanced biomass gasification combined-cycle systems are expected to emit very little NO_x—0.0005 tons/MWh; Margaret K. Mann and Pamela L. Spath, *Life-Cycle Assessment of a Biomass Gasification Combined-Cycle System*, NREL/TP-430-23076 (Golden, CO: National Renewable Energy Laboratory).

Source: Based on Electric Power Research Institute (EPRI) and U.S. Department of Energy, *Renewable Energy Technology Characterizations*, EPRI TR-109496 (Palo Alto, CA: EPRI, 1997).

words, the total number of allowances available to fossil fuel generation is reduced.

- The pool of allowances is divided up between fossil generators and renewables so that wind, solar, biomass, and geothermal automatically gain allowances (either in the same amount as allowances are allocated to other generators or by some other allocation method).

- A renewable energy company decides to locate in that region, prices its product based in part on a projection of revenues from the sale of earned emission allowances, and sells its product to the public with the argument that it is reducing air pollution by producing electricity with no emissions.

- A smart reporter figures out that the system effectively internalizes the societal cost of pollution into the price of fossil-fired generation and that a consumer who purchases renewables reduces the total amount of pollution emitted, thereby positively affecting health and the environment.

- The public gains confidence in choosing renewables as a pollution remedy and buys more of them since the premium for such purchases is not very high.

Thus the design of future emissions trading programs is extremely important to the renewable industry.

PART IV. FUTURE CAP-AND-TRADE PROGRAMS

Each of the following CAA programs affects fossil-fired electric generators and could be modified to include emissions trading opportunities for renewables:

- Title IV: acid rain programs and SO_2 emission controls;

- ozone nonattainment programs, as they affect NO_x emissions;

- air toxics, in regard to heavy metal emissions from power plants;

- visibility impairment programs; and

- future climate change programs to control CO_2 and methane.

It is important to recognize that these programs and their trading mechanisms are rapidly evolving, and that there are opportunities for the renewables industry to influence these programs at both state and federal levels.

- In order to control acid rain more effectively, Congress is considering several bills that would tighten the cap on sulfur oxides and impose a new national cap-and-trade program for power plant NO_x emissions. Congress could correct the dysfunctional SO_2 clean-energy set-aside program either as part of these bills or as a separate action focused on enabling renewable energy to participate in cap-and-trade programs more generally.

- Some states are now exercising the option to include emissions trading mechanisms in plans to reduce summertime power plant nitrogen oxides emissions (pursuant to EPA's NOx SIP Call).

- In April 1999, EPA finalized its 60-year program to improve visibility in national parks, in a rule that encourages states to establish emissions trading programs to reduce SO_2 and NO_x emissions from electric power generations.

- Late in 2000, EPA will announce findings regarding health and environmental impacts from power plant air toxics, a decision that could result in tighter controls on heavy metal emissions, and potentially a cap-and-trade system for mercury.

- Internationally, climate change negotiations may result in national or global CO_2 and methane caps targeted at the electricity sector.

- Congress is considering "early reduction" legislation for greenhouse gases, and could include an incentive to develop renewables.

In each of these areas, renewable industry advocates could push for provisions that allow renewable energy firms to earn money for the clean energy attributes of their technologies. As described, an optimal combination of modified caps and multipollutant credit allocations could result in billions of dollars in annual revenues for the renewables industry.

The New Prototypes: NO_x Cap-and-Trade Programs in the East

There are currently several important opportunities to promote reform of federal and state cap-and-trade systems through the development of emission control programs concerning ground-level ozone. Although the potential financial rewards for renewables from this program are small, it could set important precedents for more lucrative multipollutant trading mechanisms.

In October 1998 EPA finalized its NO_x SIP Call, requiring 22 eastern states to submit revised implementation plans to reduce summertime NO_x emissions from utilities and large industrial boilers.[35] The rule is intended to reduce summertime NO_x emissions by a million tons and to improve air quality from Missouri to Maine and from Georgia to Wisconsin. The action will also incidentally lessen acid rain, coastal water hypoxia, visibility impairment, and fine-particle pollution.

The rulemaking is a significant development in U.S. environmental law. It initiates a new "regional" approach to meeting clean air standards and a new emissions trading mechanism. This is the first time in history that EPA has used its interstate air pollution control authority to help attain the NAAQS. Each affected state has been assigned a cap on seasonal NO_x emissions. The cap is based on an estimate of emissions that would occur in 2007.[36] The action is integral to EPA's strategy to implement the 1997 NAAQS for ozone and lays the groundwork for a similar approach to attaining the fine-particulate-matter standard.

States will have the option of allowing sources to meet obligations through emissions trading. The final NO_x SIP Call rule contains a model trading program applicable to larger sources.[37] A state NO_x emissions trading program may set aside NO_x allowances for allocation to renewables and energy efficiency. A set-aside would reduce the amount of allowances allocated to fossil-fired power plants, and instead make the allowances available to energy efficiency or renewable technology vendors. The clean energy vendors would then sell the allowances and receive revenue to support their industry.

There are many issues involved in establishing an effective state clean energy set-aside. Many would object, for example, if garbage incineration is counted as a renewable or if the nuclear industry tries to earn allowances.[38] Environmental groups may, in fact, resist a direct allowance allocation or set-aside for renewables if a proposal to do so opens the door to the same treatment for these industries. While an effective argument

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[35] 63 Fed. Reg. 57356-57504 (October 27, 1998). See also, Proposed Rule, 62 Fed. Reg. 60317 (November 7, 1997); and Supplemental Proposed Rule, 63 Fed. Reg. 25901 (May 11, 1998).
[36] In setting the state caps, EPA assumed an average emission rate limitation on utility sources of 0.15 lbs./mmBTU.
[37] NO_x emissions trading is discussed in EPA's final rule at 63 Fed. Reg. 57,356, 57456 (October 27, 1998).
[38] For example, set-asides for renewables should be taken out of emission allowances that would otherwise go to power plant operators.

can be made that separate treatment of renewables is justified by the massive differences in the environmental impacts, in some jurisdictions the power of the nuclear and “mass-burn” industries makes environmental groups wary of supporting a renewable set-aside or generation performance standard.

Details on how to set up an effective renewable energy set-aside are contained in EPA’s *Guidance on Establishing an Energy Efficiency and Renewable Energy (EE/RE) Set-Aside in the NO_x Budget Trading Program*, March 1999.[39] The Center for Clean Air Policy has also developed an excellent guide to the key issues in setting up a state NO_x trading mechanism.[40] The best approach is to allocate allowances to renewables in the same way as they are allocated to fossil generators. Alternatively, if a renewable set-aside is used, the renewable energy industry should urge states to reserve at least 10–15% of its utility NO_x budget for qualifying energy efficiency and renewable energy programs.

Independent of EPA’s NO_x SIP call, several states are adopting renewable set-asides as part of regional NO_x control programs:

- Massachusetts has proposed a program to reduce utilities’ NO_x emissions by 75 percent from 1990 levels. This program is a cap-and-trade allowance program similar to the paradigm established by the Acid Rain SO_2 allocation system.[41] The program provides for a set-aside account for renewables and efficiency. In Phase II (beginning in 2003), 1% of the total NO_x budget (135 tons) is to be set aside and awarded to energy efficiency and renewable energy developers. The system will allocate emissions to renewables at a rate of 1.5 lbs. of NO_x/MWh.[42]
- New Jersey has also adopted a NO_x cap-and-trade budget system, including an energy efficiency and renewable energy incentive.[43] Like Massachusetts, New Jersey’s allowances are allocated on at a rate of 1.5 lbs. NO_x/MWh.
- New York, in September 1999, finalized a seasonal NO_x cap-and-trade budget of 40,000 tons.[44] For the control periods between 2003 and 2007, 3% of the budgeted allowances will be made available for energy-efficient and renewable energy sources that produce power in New York. These projects are eligible for allowances for five years.

PARTICULATE MATTER AND VISIBILITY IN NATIONAL PARKS

Fine-particle-matter pollution and regional haze are caused in large part by power plant emissions. Regional haze is caused principally by the light-scattering effects of fine particles, of such as sulfate and nitrates, formed in the atmosphere from SO_2 and NO_x emissions. In order to attain the new National Ambient Air Quality Standard for PM2.5 and to improve visibility in national parks, EPA and the states will face the same combination of pollution movement and utility sources encountered with ozone and NO_x. In each case, the regulatory focus will be on interstate transport of sulfur and nitrogen compounds. As in the case of the NO_x SIP Call, states will have the option of using an emissions trading program for control of particulate emissions. The PM SIPs will be under development beginning in 2004, at which point renewable energy industries will have the opportunity to

[39] The *Guidance* is available at <www.epa.gov/appd/stat_pub.html>.

[40] Catherine Morris and Paige Shelby, *Recognizing Efficiency And* Renewable *Energy Under A Cap and Trade Program* (Washington, DC: Center for Clean Air Policy, July 1999); see www.ccap.org.

[41] See 310 CMR § 7.27 and supporting guidance documents.

[42] For more information, visit the Massachusetts state Web site at <www.magnet.state.ma.us/dep>.

[43] See N.J.A.C. 7:27.

[44] See 6 NYCRR Part 204.

press for the inclusion of a set-aside in any emissions trading program that emerges.

The visibility impairment (or haze) programs may also be implemented through emissions trading mechanisms that could result in pollution avoidance revenues for renewable energy developers. Congress set up a special program in the 1990 amendments to protect and enhance visibility in federal parks.[45] In April 1999, EPA finalized a rule that will require states to develop plans to essentially eliminate haze conditions in national parks.[46]

Although the implementation of the haze rule spans a 50-year period, there are several near-term opportunities to influence the program for the benefit of renewable energy resources. First, EPA will develop guidelines for voluntary state and regional emissions trading programs during 2000. These could encourage states to include a set-aside or direct allocation of emission credits for renewable energy generators. States that opt to include emissions trading controls (as an alternative to plant-by-plant best available retrofit technology controls)[47] will begin developing plans by 2003 for filing with EPA according to a staggered schedule between 2005 and 2008.

In addition, a 1996 Grand Canyon Visibility Transport Commission (GCVTC) report established goals for the development of renewable energy resources as one means of reducing the impact of fossil fuel electric power plants on regional visibility conditions. The report called for renewable energy resources to account for 10% of the regional power needs by 2005, and 20% by 2015. By October 1, 2000, the GCVTC is to develop an annex to its 1996 report, including an emissions trading program to become effective if any of the eight western states that opt to comply with the GCTVC's recommendations miss key milestones in improving regional haze conditions.[48]

Carbon Dioxide

As noted earlier, renewables could enjoy large financial benefits from a cap-and-trade program for CO_2 emissions if the cap is properly set and if the program contains a generation performance standard or an express set-aside of emission allowances for renewable electric power generators. The value is substantially higher than any conceivable revenue from SO_2, NO_x, or haze-control trading schemes.

The threat of climate change led to the adoption of the Framework Convention on Climate Change at the 1992 United Nations Conference on Environment and Development.[49] The meeting adopted a goal of stabilizing greenhouse gas (GHG) concentrations, but it set no emission limits or timeframes to accomplish this goal. The details were spelled out at the Third Conference of the Parties, held in Kyoto, Japan, in December 1997. This resulted in specific global emission reduction requirements for industrial countries. If the U.S. Senate ratifies the Kyoto Protocol, the United States will need to reduce its GHG emissions to 7% below 1990 levels.[50]

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[45] See CAA §§ 110(a)(2)(J), 169A and 169B; 42 USC §§ 7410(a)(2)(J), 7491 and 7492.

[46] 64 Fed. Reg. 35714 (July 1, 1999); 40 C.F.R. Part 51, subpart P, §§51.308 and 51.309.

[47] BART refers to the "best available retrofit technology," standards to be developed for sources that adversely affect visibility in "class I" national parks. To be approved by EPA, any emissions trading program must achieve greater progress in visibility protection than the implementation of source-by-source BART controls.

[48] 40 C.F.R. §51.309(f) (Arizona, California, Colorado, Idaho, New Mexico, Nevada, Utah and Wyoming).

[49] For a more detailed discussion of the Kyoto Protocol, see Christopher Flavin and Seth Dunn, *Climate of Opportunity: Renewable Energy After Kyoto*, REPP Issue Brief No. 11 (Washington, DC: July 1998).

[50] A key strategy to meet this goal will be to address heavy and growing reliance on coal to generate electricity. Coal combustion in U.S. power plants caused more than 400 million tons of carbon emissions in 1990.

At the November 1998 Conference of the Parties in Buenos Aires, however, treaty members postponed negotiations on an international emissions trading system. The next gathering, in Bonn in late 1999, further postponed tough decisions as the negotiators focused on rebuilding confidence in the protocol. In the absence of an agreement to implement international CO_2 trading, a cap-and-trade system could be implemented domestically to meet the U.S. emission reduction obligations. EPA views the NO_x SIP Call cap-and-trade system as an appropriate model for trading GHG emissions allowances.

The Clinton administration and members of Congress are proposing an "early reduction program" that will provide emission credits for sources that reduce emissions prior to ratification of the Kyoto Treaty. The debate over this early reduction provides an important near-term opportunity to carve out a role for renewables in CO_2 trading. At least one congressional bill, introduced by Senators Connie Mack and Joseph Lieberman, would amend the CAA to authorize the President to enter into binding agreements with businesses operating in the United States that achieve voluntary emission reductions prior to January 2008.[51] A business would receive Greenhouse Gas Reduction Credits if it "takes an action that reduces greenhouse gas emissions." The credits could be used in any future domestic program to mitigate GHG emissions.[52]

The bill as currently drafted, however, is unclear on whether electricity generation from renewables qualifies as such an "action" and appears to limit eligibility for credits to the owners of facilities that emit greenhouse gases. The bill could be amended to state that renewable energy project developers can earn credits directly, without the need to work through a utility or fossil-fuel-fired source.

By 2020, energy consumption worldwide is expected to be 75% above 1995 levels. Development of wind, solar, and biomass energy resources should be a key strategy to cement the Kyoto Protocol into a working, cost-effective pollution-control mechanism. The renewable energy industry needs to become a part of the negotiating process at both the domestic and the international level.

PART V. RECOMMENDATIONS AND ACTION PLAN

The revised Clean Air Act could result in more complete protection from acid rain, smog, and utility toxics, and at least a first step toward climate protection. It may also be the policy event by which energy policy will be intertwined with air quality more than ever before, this time on a global scale.

The debate over the next CAA could be a major opportunity for renewable industry—if it chooses to play. All the recommendations made here require the involvement of renewable energy advocates and firms, as well as sympathetic environmental groups and government officials, early in the policymaking process.

Recommendations for Federal Policy Changes

Several activities could correct the currently dysfunctional renewable energy elements of the SO_2 trading system, and to popularize the concept of renewable energy set-asides through the ozone-NO_x State Implementation Plans. Also, the renewables industry must secure a place at the table when the parameters on carbon pollution regulation are set.

The following recommendations are intended for air regulators, legislators and the renewable energy industry if they are considering ways to craft air pollution regulation to accord direct benefits to renewable energy:

[51]The Credit for Voluntary Early Action Act by Senators Chafee, Mack, and Lieberman, initially introduced as S. 2617, and later as S.547, in the 106th Congress.

[52]For more information on early actions for climate change see Robert C. Nordhaus and Stephen C. Fotis, *Early Action and Global Climate Change: An Analysis of Early Action Crediting Proposals*, from the Pew Center for Global Climate Change, at <www.pewclimate.org>.

Conventional Air Pollution Control Programs

- Continue and expand the EPA program to encourage state efforts to adopt renewable set-asides in state and regional emissions trading programs to control ground-level ozone, attain particulate matter standards, and improve visibility in national parks.
- Reduce the sulfur dioxide cap to the level needed to protect human health and sensitive ecosystems fully and then, in a second step, reduce the cap again to reflect objectives for renewable energy development The "modified" cap could be implemented through a generation performance standard with a direct allocation of allowance to renewables, or set-aside allowances for renewables. Alternatively, Congress could fix the SO_2 cap-and-trade system to cure the limitations on who can earn credits and could extend the period in which credits can be earned.
- Replace pollutant-by-pollutant emission credit systems with a multipollutant trading paradigm that merges allocation, verification, and tracking systems for all pollutants in order to reduce administration and transaction costs.

Climate Change

- Ensure that any CO_2 emissions trading scheme contains a cap that is tight enough to stimulate markets for renewable energy resources (either domestic or international) and that, in setting emission caps, lowers the tonnage allowed from fossil fuel generators by an amount based on projected electric power generation from renewables ("modified cap").
- Make renewables eligible to earn "early reduction" credits in any U.S. early reduction credit bill.
- Create a specific allowance allocation award or set-aside for renewables in any full-blown carbon cap-and-trade system.

Recommendations for State Policy Changes

- Establish an allowance set-aside for renewables in state plans designed to implement the NO_x SIP Call, visibility, and ozone and particulate nonattainment programs.
- Experiment with multipollutant trading mechanisms.
- Develop, in conjunction with EPA, low-cost systems to verify eligibility for emission allowance allocations to renewables.
- Experiment with assigning emission allowances for aggregations of small and distributed renewable energy resources (e.g., rooftop solar photovoltaic systems, small wind turbines).
- Encourage EPA to establish pilot programs with cooperating states that combine implementation of NO_x trading programs with voluntary state climate change programs.
- Establish a preapproval process to provide project applicants with more certainty about the incentives to be awarded.

Steps Toward the Goal

- Draft legislative language to achieve congressional objectives and to fit into a variety of possible vehicles, including corrections to the acid rain SO_2 trading reserve for renewables, modifications to pending "early reduction" bills, creation of a multipollutant trading mechanism for renewables, and some role for CO_2 trading in any bill implementing future treaties on climate change.
- Form coalitions among a variety of renewables industries to seek sponsors and cosponsors of bills and to work with environmental groups.
- Draft policy papers on the proposed changes, providing a more detailed rational and factual analysis of renewable energy's role in a generation performance standard, or alternatively the size of the requested set-asides, and an estimate of the economic, health, and environmental benefits of the policy changes.

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