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The Clean Air Act and Renewable Energy: Opportunities, Barriers, and Options

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Introduction

Regulating various combustion byproducts such as sulfur dioxide (SO_2), nitrogen oxides (NO_x), carbon dioxide (CO_2) and other greenhouse gases (GHGs) offers opportunities for promoting greater penetration of renewable energy technologies in the market place. One such opportunity is the SO_2 emission cap-and-trade approach embodied in the acid rain control program found in Title IV of the Clean Air Act (CAA) amendments. Other opportunities arise under the various NO_x trading programs and the regional haze rule. In the longer term, possible regulations implementing CO_2 trading in conjunction with international climate control agreements offer significant potential for promoting renewable energy sources. There are, however, barriers to taking advantage of these opportunities, such as low allowance prices, restrictive eligibility requirements, electricity restructuring, unfavorable allowance allocation schemes, political obstacles, and complex and overlapping regulatory requirements.

This paper examines the opportunities, obstacles, and potential options to promote renewable energy under the CAA and related programs. The focus is on electricity generation. It deals, in sequence, with regulating SO_2, NO_x, regional haze/particulate matter, and CO_2. For each pollutant, the paper discusses the opportunities, barriers, and options for boosting renewables under the CAA. It concludes by comparing the options discussed. Note that the paper is more oriented toward the perspective of renewable energy advocates than that of air quality regulators. Note also that, as compared to that presented at the December 4-6, 2000 Association of Energy Service Professionals, International conference, this version contains some updated information and additional editing.

The paper is based on a project on environmental regulation and renewable energy in electricity generation conducted by the National Renewable Energy Laboratory (NREL) for the Office of Power Technologies, Office of Energy Efficiency and Renewable Energy, U.S. Department of Energy. David Wooley and Elizabeth Morss are the consultants to the project, and Jeff Fang is the NREL technical monitor. The final report for this project was published in January 2001.[1]

SO_2 and the Conservation and Renewable Energy Reserve

Opportunities

Title IV of the CAA addresses the acid rain problem caused by SO_2 and NO_x emissions. The program takes an emission cap-and-trade approach, which is implemented in two phases. The total emission cap for SO_2 is set at 8.9 million tons for utility sources with greater than 25 MW of generating capacity. Phase I, which started on January 1, 1995, established an allowable emission rate of 2.5 lbs/million Btu (MMBtu) for affected sources. Phase II starts on January 1, 2000, with a 1.2 lbs/MMBtu allowable emission rate. In both phases, allowances are allocated to the affected plants according to a formula based on the base-period heat input rates. An allowance is an authorization to emit one ton of SO_2 under applicable conditions.

Under the acid rain program, an affected plant is prohibited from releasing emissions of SO_2 in excess of the number of allowances held by the plant's owner. Generators have various options for addressing SO_2 emissions, including installing scrubbers, repowering, fuel switching, substituting more efficient plants, implementing energy-efficiency programs, constructing renewable energy facilities, and buying allowances. SO_2 allowances can be transferred, traded, and banked. Allowance trading enables the utility industry as a group to reduce the economic costs of complying with the required emissions reductions. Generation plants that can reduce their SO_2 emissions at low cost can overcontrol, leaving extra allowances for sale in the allowance market. Those with high-cost emission-control methods may opt to purchase the allowances instead of incurring the cost of direct control.

To encourage utilities to use energy efficiency/renewable energy (EE/RE) to reduce SO_2 emissions, the CAA set up a Conservation and Renewable Energy Reserve (CRER). CRER is a pool of 300,000 bonus SO_2 allowances that were set aside for rewarding electric utilities that use energy efficiency or renewable energy including biomass, solar, geothermal, wind, and landfill gas to reduce SO_2 emissions. This amount represents about 3% of the total emission cap of 8.9 million tons. Utilities with Phase I plants could earn CRER allowances for measures implemented or installed between January 1, 1992, and January 1, 1995. Utilities with Phase II plants could earn such allowances for EE/RE measures installed between January 1, 1992, and December 31, 2000. Utilities can file applications until January 1, 2010.

The 300,000 allowances under CRER come from the allocation of allowances to Phase II plants. Each year, from calendar years 2000 to 2009, total allocations to all the Phase II plants are reduced by 30,000 allowances for this purpose. The CAA also provides that allowances remaining in the CRER on January 2, 2010 will be allocated *pro rata* to all units affected by Phase II.

In essence, the CRER allowances are special credits given to early implementation or actions focusing on EE/RE. The U.S. Environmental Protection Agency (EPA) regulations on CRER require that at least 20% of the total reserves be allocated to either energy efficiency or renewable energy, depending on which is the more frequently used. Because energy efficiency was the more frequently used alternative, a minimum of 60,000 allowances was reserved for renewable energy.

The CRER calls for computing avoided emissions at a rate of one allowance for every 500 MWh of electricity saved through energy efficiency or generated using renewable energy technologies. This is equivalent to 0.4 lbs of SO_2 per MMBtu.[a] By comparison, the average emission rate of Phase I units is 2.5 lbs/MMBtu and that of the Phase II units is 1.2 lbs/MMBtu.[2, 3] As discussed below, this relatively low conversion rate is one reason the CRER did not provide the expected incentive for renewables.

As of December 2000, only 43,965 allowances out of a total reserve of 300,000 (about 14.7%) had been awarded. Among them, 10,364 were awarded to renewable energy projects.[4] Although applications for allowances can still be filed until 2010 for units installed prior to the deadlines, this level of participation is generally regarded as a substantial under-subscription of the allocated reserves.[b]

Barriers

Several plausible factors contributed to the under-subscription of the CRER program. First, the price of SO_2 allowances turned out to be much lower than expected. Initially, the price was approximated by the cost of compliance, which was estimated to be approximately $400 to $1,000 per ton. Congressional analysts estimated that allowances would sell for about $750 each.[5] The CAA set an auction price for allowances at $1,500 each. In actual auction and trading, the average monthly price of SO_2 allowances was as low as $69/ton in 1996. In 1999 and 2000, it ranged from $135/ton to $217/ton.[6] For many utilities, it was cheaper to buy SO_2 allowances in the market than to pursue allowances under the CRER program.

Second, as noted above, the low conversion factor for computing the number of allowances to be awarded—one allowance for 500 MWh, or 0.004 lbs per kWh—discouraged participation in the CRER program.

Third, the program limited participation to utilities. Renewable energy developers—the group that would benefit most from the CRER—could not participate unless they joined with a utility.

Fourth, the CRER statute and implementing regulations were developed when utilities were highly regulated. As a result, they required applicants for CRER credits to comply with net income neutrality and least-cost energy planning requirements. With the advent of electric industry restructuring, these requirements are no longer appropriate and may have provided utilities with a disincentive to participate in the CRER program.

Fifth, electric utilities have been preoccupied with other more important issues such as restructuring, retail competition, selling off generating assets, and corporate mergers and convergence. The relatively small sum of potential reward, in terms of SO_2 allowances received,

[a] Assume 1 kWh of electricity is equal to 10,000 Btu of primary energy.
[b] For additional discussion , see Section III of the final report.[1]

the administrative burden of qualifying for the CRER award, and the need to divert management attention from the larger issues, combined to deter utility managers from applying for the CRER allowances.[c]

Options

The cap-and-trade program under Title IV of the CAA is the maturest emissions-trading program currently being implemented. Despite some initial skepticism in the environmental community about the merits of such a market-based approach, the program is generally regarded as a success, resulting in significant, cost-effective reductions in SO_2 emissions from utilities. In light of its success, Title IV presents significant opportunities for encouraging development of renewable energy. Several options are set forth below, all of which would require congressional action to amend the CAA.

Option 1: Tighten the Existing SO_2 Cap

As noted above, one reason for the CRER's failure was the low price of allowances. From a utility's perspective, it was simply more cost-effective for sources to buy allowances than to construct new renewable energy projects. Lowering the SO_2 cap will make renewables more attractive financially relative to conventional electric generation, while at the same time reducing emissions that contribute to acid rain. Perhaps the chief advantage of this approach is that there is already significant support in Congress for reducing the SO_2 cap, as evidenced by the various bills introduced in the past two years supporting such a reduction. Unfortunately, lowering the cap alone is unlikely to be enough to encourage renewables development, at least in the short term. Accordingly, the renewables industry needs to pursue a renewables set-aside as part of any legislation to reduce the SO_2 cap.

Option 2: Establish an Improved Allowance Set-Aside Program for Renewables to Replace the CRER

As noted above, the CRER failed to achieve its goal of promoting renewable energy and energy efficiency, in part because the rewards of participating are low (in terms of the quantity and value of allowances awarded) relative to the administrative and other burdens of participating. Using this experience as a guide, the renewable community could develop support for an improved set-aside program. Such a program would include the following key elements: (1) a set-aside of 5% of total SO_2 allowances for renewables by 2003 (growing to 10% by 2013); (2) participation by all renewable energy developers, not just utilities, and elimination of least-cost planning and utility income neutrality eligibility requirements; and (3) award of allowances for a minimum of 5 and as much as 10 or more years, in recognition of the high up-front costs typically associated with renewable energy development. Although the process of allocating credits under a set-aside program obviously has political implications, this approach is likely to be less politically charged than an output-based system. (See Option 3 below.) The latter would inevitably be opposed by coal and oil-fired utilities, which are likely to be disadvantaged relative

[c] The discussion is partially based on telephone conversation with Rick Morgan of the Acid Rain Program, EPA, on September 28, 1999.

to cleaner sources such as natural gas-fired utilities and renewables. Moreover, policymakers are generally comfortable with the set-aside approach, making revisions to the CAA more likely.

Option 3: Phase Out the Existing SO_2 Allowance Allocation Method in Favor of an Output-Based System that Includes Renewables

Currently, the acid rain program allocates emission allowances according to the heat input embodied in the fossil fuels, with a certain amount set aside for renewables. The amount of this set-aside is based on political considerations, making it difficult to achieve the optimal allocation from an economic perspective. One possible alternative is to allocate allowances based on the electricity output of the different generating plants without regard to the types of fuel used. Theoretically, such a method could ensure that the market recognizes the environmental benefits of renewable energy relative to conventional fossil fuel-fired plants. This output-based allocation scheme could be simpler to administer than the heat-input-based approach because there is no need to decide on the size of the set-aside pool, what entities and projects should be eligible for allowances, and whether and how to focus on new projects. Furthermore, many policymakers favor this approach. However, an output-based approach would likely be opposed by coal- and oil-fired power plants, which would likely have to incur large sums to buy allowances from gas-fired and renewable plants to meet the requirements. An additional political obstacle relates to nuclear power plants, which emit few conventional contaminants but nevertheless raise environmental concerns.

Option 4. Phase Out Existing Allowance Program in Favor of an Allowance Auction System

Instead of allocating the allowances based on the heat input of fuels used or the output of electricity generated, the government could cap emissions of one or more pollutants and then auction the allowances needed to operate under the cap to the highest bidder. A variation of the approach is to allocate a portion of the allowances using an input- or output-based approach and then auction the remainder. The revenues from the auction could then be used to offset other taxes or pursue other policy objectives, such as promoting renewable energy. This approach is economically efficient. Auctions allow the market to decide the value of allowances, reducing transaction costs; they also allow new sources the same access to allowances as existing ones. However, this approach may result in some facilities encountering operational uncertainty because they may not receive any allowance allocations and would have to acquire them in the open market. This problem can likely be mitigated by auctioning allowances well in advance of the year in which they are needed. Another obstacle is political concerns. Auctions arguably function as a tax that is paid by facilities that need to obtain allowances to operate. As such, they are likely to be opposed by those facilities, including coal and oil-fired plants that requires the greatest number of allowances to operate.

Option 5. Combine an Improved SO_2 Allowance Allocation for Renewables with a System for Other Pollutants Emitted from Power Plants

The existing CAA emission-trading programs focus on a single contaminant—either SO_2 or NO_x.[d] An alternative strategy is to use a simplified system for allocating allowances for several pollutants using a traditional or output-based allocation scheme. This system could include a specific role for renewable energy in the form of set-asides or other mechanisms, such as a renewable portfolio standard (RPS), and/or generation performance standard. To prevent possible concerns about the different environmental impacts of the various contaminants, the program would not allow inter-pollutant trading.

Such a system would more fully account for the environmental benefits of renewables. If properly designed, it would also be simpler to implement than several single-pollutant programs. The caps and allocation for various pollutants would be coordinated, avoiding the waste that may occur when single-pollutant programs overlap. To renewable energy developers, potential revenue streams from a multi-pollutant system would be much larger and more stable than multiple single-pollutant programs.[7]

There are barriers to adopting multi-pollutant programs. Ideally, existing control programs should be abolished or consolidated into the new program. This may present both a political and administrative challenge. In addition, renewable energy would benefit most from a multi-pollutant program that includes CO_2. As will be discussed later, however, there is considerable political opposition in Congress to capping CO_2 emissions in the short run.

NO_x Trading Programs

Opportunities

The CRER represents the federal government's first significant attempt to encourage the development of renewable energy through clean air regulation. Since 1990, however, both the EPA and the states have launched emissions-trading programs that both directly and indirectly promote renewable energy. These programs are targeted primarily at reducing NO_x, an important precursor to the formation of ground-level ozone and acid rain.

NO_x State Implementation Plans (SIP) Call

In September 1998, the EPA issued a final rule for addressing ozone transport through regional NO_x emission reductions. The rule, commonly referred to as the NO_x SIP Call, requires 22 states in the eastern United States and the District of Columbia to submit revised SIPs that address the regional transport of ground-level ozone. It is aimed at reducing NO_x emissions, improving air quality, and reducing ozone transportation across state boundaries in the eastern half of the United States. The SIP Call requires emission-reduction measures to be in place by May 1, 2004.

[d] The cap-and-trade program for NO_x is discussed in the next section.

The rule aims to reduce total summertime (May 1 through September 30) emissions of NO_x by about 28% (1.2 million tons) beginning in the year 2004 in the 23 affected jurisdictions. The goal is to bring the majority of all new ozone nonattainment areas into attainment with the ozone standard, while still allowing states to choose their own compliance options. To help the states achieve this goal, the SIP Call rule establishes a model NO_x Budget Trading program that will allow states to achieve more than 90% of the required emission reductions in a cost-effective manner. States interested in achieving compliance using a trading program can either incorporate the federal program by reference or adopt their own state programs with minor changes.

Under the SIP Call, the EPA set the emission limits for each affected state. The states are then responsible for allocating allowances among affected sources, including new sources. Allocated allowances can be banked or traded among sources in the participating states within the region. The EPA will administer the allowance transfer process and use the NO_x Allowance Tracking System (NATS) to track allowances held by affected sources. Actual emissions will be monitored, reported, and recorded in the EPA's Emission Trading System (ETS). At the end of each ozone season, each account will be reconciled by matching emissions in the ETS to allowances recorded in the NATS.

With the implementation of the NO_x Budget Trading Program, there are two opportunities for renewable energy technologies. First, sources in each state that have been allocated NO_x allowances can substitute renewable electricity generation for fossil-fired generation, and either sell or bank the allowances for later use. From the perspective of the emission sources, this option would be cost effective if the additional cost of renewable generation over conventional generation is less than the cost of NO_x allowances.

Second, the EPA encourages states to include in their SIPs a set-aside program for using energy efficiency and distributed renewable energy to help reduce NO_x emissions. This set-aside is a voluntary program intended to reduce the total economic cost of meeting the NO_x budget and to accelerate the adoption of energy-efficient practices and technologies, and renewable energy. The EPA has issued a guidance document for states to use in establishing a voluntary set-aside program.[8]

Under the program, a state would reserve a portion of its total NO_x emissions budget to award to non-electric generating units (non-EGU) and electric generating units (EGU) who take energy efficiency, renewable energy, and combined heat and power (CHP) actions. Non-EGUs may take demand-side management (DSM) activities within their own facilities and apply for EE/RE set-aside allowances based on the resulting amount of electricity savings. EGUs can also conduct DSM activities outside their own facilities and receive similar credit. On the supply side, non-EGUs can retire a generating unit and replace it with a CHP unit or renewable energy project including wind, solar, biomass, and landfill gas operations, meeting increased demand for steam or electricity with the output from the new project. The award will be based on the amount of electricity used to displace other types of generation and nets out the amount of NO_x emissions from the CHP operations.

The EPA suggests that states set aside 5%–15% of the total NO_x budget for the EE/RE program. Because the allowances granted in the set-aside program come directly from the total state NO_x budget, the program is consistent with the objective of reducing total NO_x emissions embodied in the overall budget. In addition to deciding the size of the set aside, the states must determine who is eligible for EE/RE awards, how to focus awards on new projects, and whether to award allowances for early actions. States also must determine the length of an award period and how to adjust the size of the set-asides to accommodate the level of demand.

The allowances will be available to end users of all types, including aggregators, vendors, and others. Eligible entities include commercial and industrial building owners and operators; energy service companies; home builders and associations; homeowners associations; federal, state, and local government agencies; commercial businesses; manufacturers; and other industrial energy users, as well as manufacturers leasing or selling energy-efficient equipment. Aggregators and energy service providers who do not own fossil-fired generation facilities are also eligible.

States were initially required to submit their revised SIPs by September 30, 1999, and to implement their NO_x SIP Call programs by May 1, 2003. In addition, states were required to achieve their overall NO_x budgets by September 2007. The NO_x SIP Call was challenged in court on various grounds. However, the Court of Appeals eventually rejected the challenge, and SIP submissions were due October 30, 2000. The new implementation deadline is May 2004.

Section 126 Petitions

Section 126 of the CAA authorizes one state to petition the EPA for a finding that a major source or group of sources in another state is emitting pollutants at levels that contribute significantly to nonattainment in, or interference with maintenance by, that state. Prior to the NO_x SIP Call, eight states from the New England and Mid-Atlantic regions submitted so-called Section 126 petitions to the EPA seeking such a finding.

Following an initial Court of Appeals ruling staying the implementation of the NO_x SIP Call in May 1999, the EPA granted the Section 126 petitions of Connecticut, Massachusetts, New York, and Pennsylvania. In doing so, the EPA set emissions limits for specific sources in other states that contribute significantly to the air quality problems in the petitioning states. A total of 392 facilities, including electric utilities and large industrial generators in 12 states (Delaware, Indiana, Kentucky, Maryland, Michigan, North Carolina, New Jersey, New York, Ohio, Pennsylvania, Virginia, and West Virginia) and the District of Columbia must reduce annual NO_x emissions by 510,000 tons from 2007 levels.[9] Facilities covered by the EPA's 126 ruling must participate in a mandatory NO_x cap-and-trade program known as the Federal NO_x Budget Trading Program. Like the SIP call regulations, the EPA's Federal NO_x Budget Trading program under CAA 126 also allocates allowances on an input basis. Effective in 2008, however, the EPA will allocate allowances on an updating output basis. Under this approach, the EPA will award allowances based on the quantity of energy generated, updating the allocation every five years. The EPA declined to decide, however, whether the output-based allowances would be awarded to all electric generating sources, including renewables, or only to fossil fuel-fired sources.

State Programs Under Ozone Transport Commission (OTC)

In addition to the federal programs above, the states in the Northeast Ozone Transport Region (OTR) have implemented their own NO_x emissions-trading program in an effort to attain the federal standard for ozone in that region. In 1994, the states entered into a Memorandum of Understanding (MOU), in which they agreed to enact regulations implementing a NO_x cap-and-trade program. The program, which applies during the summer months when ozone problems typically occur, ultimately will reduce NO_x emissions from utilities in the region by about 50% from the baseline years. Although not required by the MOU, the following states in the OTR have included set asides for renewables in their implementing regulations:

- **Massachusetts**. This program would reduce utilities' NO_x emission by 75% from 1990 levels. Starting in 2003, 1% of the total NO_x budget is to be set aside for energy efficiency and renewable energy.

- **New Jersey**. New Jersey also adopted a NO_x cap-and-trade budget system, including an EE/RE set-aside. The allowances are allocated at a rate of 1.5 lbs of NO_x per MWh.

- **New York**. In September 1999, New York finalized a seasonal NO_x cap-and-trade budget of 40,000 tons. For 2003 to 2007, 3% of the budget allowances will be set aside for EE/RE.[e]

NO_x Control Under the Acid Rain Program

The CAA Title IV acid rain program calls for reducing NO_x emissions from utility boilers by 2 million tons below the 1980 level, using a two-phase approach. Under Phase I, emission limitations for dry-bottom-wall-fired boilers and tangentially fired boilers (Group 1) took effect on January 1, 1996. Under Phase II, the EPA set more stringent standards for Group 1 boilers. The EPA also set emission limitations for Group 2 boilers, including wet-bottom-wall-fired boilers, cyclone boilers, boilers using cell-burner technology, and other coal-fired boilers.[f]

Barriers

To date, none of the NO_x trading programs specifically establishes a role for renewables. The NO_x SIP Call, for example, depends on the willingness of individual states to develop a cap-and-trade approach and include it in their SIPs. To encourage renewables, state air regulators must be convinced of the environmental and other benefits of renewable energy, while electric generators located in the state must be willing to experiment with renewable energy options. They must be willing to devote the time and resources to develop a cap-and-trade program and to consider a renewable set-aside or other similar program. Without a better understanding of the issues involved, and without adequate staff and funding resources, the states may not be willing to pursue renewable energy options.

[e] For additional details of the control on NO_x and ground-level ozone, see Section IV of the final report.[1]
[f] For more details on the NO_x emissions control in the Acid Rain program, see[10, 11].

Although the EPA is mandating a NO_x cap-and-trade program under the rules implementing reductions under CAA 126, that program does not currently address renewables, nor has the EPA committed to including renewables when it switches from an input- to an output-based formula for allocating allowances in 2008. Again, the renewables industry must work to ensure that the final program includes a specific role for renewables.

Ultimately, efforts to boost renewables by targeting NO_x emissions may be hampered by several factors. First, all of the programs developed thus far apply to specific regions, in large part because they are targeted at addressing ozone nonattainment, a regional problem. To date, there is no nationwide cap-and-trade program for NO_x. Second, as the above summary suggests, facilities in the northeastern states in particular will soon be subject to multiple NO_x trading programs, raising significant administrative and other concerns. Decisions regarding how to address NO_x emissions from utilities in the future must take this fact into account.

Options

Option 1: Encourage Renewables Under Existing Programs Established by the Northeast Ozone Transport Region Under Its Existing MOU, the NO_x SIP Call, or CAA 126 Rulemaking

States in the OTR are required to implement a cap-and-trade program to reduce NO_x emissions. In the short term, state regulations implementing the MOU could be specifically amended to establish a role for renewables in those states that have not already done so. In the longer term, further reductions in NO_x emissions could be required, making renewables a more "valuable" alternative relative to other emission reduction strategies. Additional programs could also be developed (set-asides, RPS, and systems benefits charges) to specifically encourage renewables development. The OTC currently is exploring these options and expects to issue a final assessment by the winter of 2002. The renewables industry should participate in this process to ensure that its interests are addressed.

Additional opportunities to boost renewables also arise under the EPA's NO_x SIP Call and CAA 126 rulemakings. As previously noted, the SIP Call gives states the option of achieving the necessary emission reductions by implementing a NO_x trading program; the 126 rulemaking, by comparison, establishes a mandatory trading program for the 392 sources covered by the rule. Although neither program specifically establishes a role for renewables, in the case of the SIP Call, the EPA has encouraged states to adopt trading programs with EE/RE set-asides and has provided guidance for developing such programs. As with the OTC MOU previously discussed, the key for the renewables industry is to ensure that as many states as possible avail themselves of this option.

Option 2: Pursue a National or Regional NO_x Cap-and-Trade System with a Renewable Set-Aside

In contrast to Option 1, this option would expand the scope of coverage nationwide and, thus, has the potential for realizing larger gains for the renewable energy industry. Several bills have been introduced in Congress that would establish a nationwide NO_x cap-and-trade program.

There are three keys to successfully implementing this option. First, build support for the need and feasibility for a nationwide NO_x cap-and-trade program and for setting the cap low enough to ensure meaningful NO_x reductions. Second, include a set-aside or other similar mechanism to establish a specific role for renewables. Third, coordinate a nationwide program with the existing cap-and-trade programs discussed above to ensure that facilities, particularly in the Northeast, are not overwhelmed by a multiplicity of NO_x trading programs.

Option 3: Combine an Improved NO_x Renewable Allowance Allocation Requirement with a System for Other Pollutants Emitted from Power Plants

Option 3 is an application of the multi-pollutant approach discussed above under Option 5 in the SO_2 programs. The benefits of more fully accounting for the environmental benefits of renewable energy and reducing administration costs apply here as well.

Visibility Impairment, Regional Haze, and Particulate Matter

Opportunities

Other opportunities to promote renewable energy development may arise under federal programs to address visibility impairment and regional haze, which are caused, in large part, by emissions of SO_2 and NO_x, and programs addressing particulate matter (PM). As discussed below, federal regional haze regulations provide all states with the option to implement an emissions-trading program as an alternative to conventional controls. In addition, states in the Grand Canyon Visibility Transport Region (GCVTR) have the option to implement a program that establishes specific renewable energy goals. If properly implemented, both of these programs could potentially provide a boost to renewable energy.

Regional Haze

The CAA has regulated regional haze since 1977. However, the program was limited to addressing smoke plumes that were "reasonably attributable" to a specific source or group of sources. As part of the 1990 CAA Amendments, Congress expanded the regional haze program to address more widespread haze problems. The Act focuses both on regional haze problems specifically affecting the Grand Canyon and on broader regional haze concerns.

With respect to the Grand Canyon, the EPA established the Grand Canyon Visibility Transport Commission (GCVTC) pursuant to Section 169B of the CAA. The Commission undertook an extensive review of scientific, technical, and other information to assess visibility in the nine states in the GCVTR[g] and issued its final report in 1996.[12] The report emphasized pollution prevention as a tool for addressing visibility impairment. In particular, it encouraged reliance on renewable energy such as wind, solar, geothermal, and biomass through the establishment of goals for member states "to achieve annual additions in order that renewable energy will comprise 10% of regional power needs by 2005 and 20% by 2015." Other recommendations in

[g] The nine states are Arizona, California, Colorado, Idaho, Nevada, New Mexico, Oregon, Utah, and Wyoming.

the report supporting achievement of these goals include: (1) higher priority for pollution prevention through education and innovative technologies; (2) modeling the effects of renewable energy and pollution prevention; (3) providing federal incentives for pollution prevention; (4) considering fees based on the quantity of pollutant emitted; and (5) introducing green labeling, including provision of information to consumers on the characteristics of their sources of energy.

In July 1999, the EPA issued its Regional Haze Rule. The rule, which will be implemented over 60 years, requires all 50 states to establish goals and emission-reduction strategies for improving visibility in the nation's 156 mandatory Class 1 national parks and wildness areas. Unlike other CAA programs, the regional haze regulations are goal-oriented rather than prescriptive, leaving states with considerable discretion to design and implement their own regional haze programs. Among other things, the law requires states to identify stationary sources that should install Best Available Retrofit Technology (BART) and establish emission limits based on BART; in the alternative, states can implement an emission trading program that will achieve greater progress in improving visibility than source-by-source BART.

States in the GCVTR have the option to implement the basic regional haze program or to implement special regulations based on the recommendations of the GCVTC. The GCVTR rule requires the SIP to include provisions for monitoring and reporting SO_2 emissions to determine whether five-year milestones in emission reductions have been achieved. If a milestone is not met, the state must implement a backstop emission-trading program. The state must also contribute toward meeting specific renewable energy goals for the region; these goals call for renewable energy to comprise 10% of the region's energy needs by 2005 and 20% by 2015. The Western Regional Air Partnership (WRAP)—the successor to the GCVTC—is responsible for submitting recommendations for implementing the regional haze program in the GCVTR. WRAP recently issued a final report summarizing the important elements of the backstop-trading program. The program calls for renewable sources to receive 2.5 tons of SO_2 allocations per MW of installed nameplate capacity in the event the backstop trading program is implemented.[h]

Particulate Matter

Fossil fuel-fired power plants are also a significant source of PM. PM is a generic term for a broad class of chemically and physically diverse substances that exist as discrete particles, either liquid droplets or particles. PM originates from a variety of sources, both natural and man made. It can be emitted directly or formed in the atmosphere by transformations of gaseous emissions such as sulfur oxides (SO_x), NO_x, and volatile organic compounds. Like ground-level ozone, PM can travel long distances, causing damage hundreds or thousands of miles beyond its point of emission.

PM is one of six criteria contaminants for which national ambient air quality standards (NAAQS) have been set. Accordingly, each state must include in its SIP the measures it will implement to attain and maintain the NAAQS for PM in the state. To ensure that the NAAQS reflect current science, the CAA requires the EPA to review each NAAQS every five years. The EPA has revised the basis for the PM NAAQS several times. Recently, it added standards for $PM_{2.5}$—PM

[h] For additional discussion on visibility impairment and regional haze, see Section V of the final report.[1]

with an aerodynamic diameter less than or equal to 2.5 microns—and revised the basis for the pre-existing PM_{10} standard. To implement the new $PM_{2.5}$ standard, the EPA is required to undertake extensive ambient air-quality monitoring to help it and the states determine which areas do not meet the new NAAQS and the location of major sources of $PM_{2.5}$. This monitoring is crucial to the implementation of the regional haze program, which is triggered by the designation of areas as attainment, nonattainment, or unclassifiable for $PM_{2.5}$.

Immediately following the adoption of the new PM standards, various states and industry groups brought suit seeking to overturn them. In a controversial decision, the Federal Court of Appeals in *American Trucking Association v. U.S. Environmental Protection Agency* remanded both standards back to the EPA for further consideration. In so doing, the court vacated the revised PM_{10} standard; as a result, the existing PM_{10} standard continues to apply. In a subsequent decision, the court ruled that the $PM_{2.5}$ standard should remain in place pending the remand to the EPA. The Supreme Court heard arguments in *American Trucking* in early November, and a decision is expected by July 2001.[i]

Barriers

As described above, the EPA's program to address visibility impairment and regional haze has a relatively long time horizon; it is presently still in the preliminary stages. Recommendations for implementing the regional haze program for the GCVTR states, including SO_2 emissions milestones and basic elements of "backstop" emission trading programs, have been developed by the WRAP. In addition, the EPA needs to conduct extensive ambient air quality monitoring.

With respect to PM, the court challenge to the new PM standard has created significant uncertainty. More specifically, the *American Trucking* decision has slowed the implementation of the $PM_{2.5}$ standard. It follows that the earliest any new SIP submissions would likely be required is the latter part of this decade. In the absence of any requirement to revise their SIPs, states are unlikely to pursue innovative PM control strategies that incorporate renewable energy. Moreover, until the initial $PM_{2.5}$ monitoring effort is completed, it will be difficult to judge whether the PM nonattainment problem is widespread enough to be a driver for renewables. This monitoring data should be available by the middle of 2001.

Options

Option 1: Adopt State or Federal Programs Specifically Targeted at Controlling PM Through Cap-and-Trade Programs

Utilities are a significant source of both direct PM emissions and of gases that react to create PM. As a result, any emissions trading program targeted at PM could create significant opportunities for renewables, assuming the cap is set low enough. Thus, state regulators could adopt programs, such as a PM cap-and-trade system, directly targeting emissions of PM. In addition, Congress could amend the CAA to establish such a program nationwide. The federal program would generate more extensive benefits than a state or regional program.

[i] The *American Trucking* decision also struck down EPA's new eight-hour ozone standard.

To date, market-based strategies to reduce utility emissions have focused primarily on PM precursors rather than PM itself. Policy makers may be reluctant to venture into the creation of a market for PM allowances in the absence of additional evidence that such a market would effectively reduce emissions.

Option 2: Establish Renewable Set-Aside or Other Renewables Incentives as Part of the Emission Trading Alternative to BART under the Regional Haze Program

Under the regional haze rule, states have the option to either adopt emission limits based on BART or implement an alternative emission-trading program. Federal support for a flexible cap-and-trade program could be linked with a request to include a renewable set-aside as a component of the system. This approach could be similar to that adopted by states implementing NO_x controls to address ozone nonattainment concerns. These provisions ultimately would be incorporated into the states' first visibility SIPs. Although most of the Class I areas targeted by the regional haze program are located in the West, the regulations concerning pollutant transport apply nationwide. Thus, unlike the NO_x SIP call and OTC programs discussed above, the regional haze trading program could potentially apply nationwide. However, as in the NO_x programs discussed above, implementing the trading program is left to the states, which have considerable discretion regarding the type of program they implement. As a result, the renewables industry must work with both the EPA and the individual states to ensure a proper role for renewables under the regional haze program.

Option 3: Pursue Renewable Energy Alternatives under the GCVTC Portion of the Regional Haze Regulations

As noted above, states in the GCVTR have the option to implement regulations based on the GCVTC report that requires those states that do not achieve specific SO_2 reduction milestones to implement a backstop trading program. The GCVTR regulations also include specific renewable energy goals. Actions to achieve renewable energy goals would certainly encourage adoption of renewable energy technologies. However, the scope of the program is restricted to states in the GCVTR, limiting its value as a means of encouraging development of renewable energy. Thus, parallel actions to extend the renewable energy targets beyond the GCVTC states are also desirable.

Control of Greenhouse Gases

Opportunities

Global concerns over the potential climate impacts of man-made GHG emissions, mainly CO_2, methane, and nitrous oxide, led to the establishment of the United Nations Intergovernmental Negotiating Committee on the Framework Convention on Climate Change. In 1992, the Rio Convention adopted a goal of stabilizing GHG concentrations but set no emission limits or time lines within which to accomplish that goal. In 1997, the Kyoto Protocol established voluntary targets for limiting GHG emissions. Overall, the industrial countries, including the former

Eastern Bloc nations, agreed to cut their collective GHG emissions to 5.2% below the 1990 levels during the 2008–2012 budget period. Each of the so-called "Annex I countries" was assigned a specific emission commitment, ranging from a 10% increase in GHG from 1990 levels (Iceland) to an 8% reduction (the European Union countries). Countries can achieve these targets either by implementing GHG reductions or by undertaking carbon sequestration projects. There is no target for developing countries.

The Protocol specifically identifies "research on, and promotion, development and increased use of, new and renewable forms of energy" as one of many options for achieving the goals and emission limits of the agreement. However, it is not a requirement. The Protocol describes a number of emissions trading options that afford the participating countries flexibility to meet their emission reduction obligations. All of these options can potentially encourage renewable energy development if properly designed and implemented.

International Emissions Trading

Nations with emission targets can trade GHG allowances. This would allow facilities with relatively low GHG reduction costs to control beyond their targets and sell the allowances to facilities in other nations with higher costs, reducing the overall cost of meeting the targets.

Joint Implementation (JI)

Countries with emission targets can obtain credits through project-based emission reductions in other Annex I countries.

Clean Development Mechanism (CDM)

Companies in Annex I countries can participate in renewable energy or other emissions-reduction projects in developing countries. The companies would benefit by gaining marketable emission credits, while the host country would receive the technology involved, thus creating employment and fostering sustainable development.

Through March 1999, 84 countries had signed the Protocol. Although several countries had ratified it, many countries are awaiting the results of ongoing negotiations on key details of implementing the agreement, including the emission trading and other programs described above. In the United States, ratification will require the advice and consent of the Senate. Many members of the Senate have concerns about the potential adverse impacts on United States businesses and the lack of meaningful participation by key developing countries.[j]

In the United States, the 1990 Amendments to the CAA require electric generating power plants to monitor CO_2 emissions and make a report to the EPA which uses this data to compute each unit's aggregate CO_2 emissions and create a publicly available database. The Amendment also requires the EPA to inventory methane emissions and to assign a "global warming potential value" to each substance listed for control under the stratospheric ozone protection provisions of

[j] For more discussion on GHG emissions and mechanisms to address them, see Section VI of the final report.[1]

CAA Title VI. Separately, Section 1605(b) of the Energy Policy Act of 1992 set up a voluntary GHG emission-reporting system through the Energy Information Administration. In 1993, the Administration launched the Climate Change Action Plan to reduce GHG emissions. It consists of a series of voluntary efforts to improve energy efficiency so as to reduce CO_2 emissions. Examples are Energy Star programs and the "Green Lights" program. More recently, the Administration proposed the "Climate Change Technology Initiative" program, using tax incentives and investment to promote energy efficiency and renewable energy technologies. Some new initiatives are aimed at encouraging development of renewable energy technologies including bioenergy, wind, geothermal, and solar energy.

Barriers

There is substantial opposition to enacting legislation on GHG control in the United States. Recent legislation giving companies that reduce their GHG emissions early reduction credits or implementing a cap-and-trade program for CO_2 are given little chance of passage in the near term. The Kyoto Protocol has not yet been submitted to the Senate for ratification because of lack of sufficient votes to pass it. One major factor in the opposition is business and labor concerns that curbing CO_2 and other GHG emissions would limit growth of industries and jobs domestically. In addition, there are concerns that some large and fast-growing third world countries have not committed to reducing their GHG emissions. At the international level, negotiations regarding implementing key flexibility mechanisms such as emission trading and CDM are continuing. However, agreement has not been reached on many key program elements. Areas of contention include: (1) whether the use of flexible compliance options such as emission trading and CDM will be limited; (2) the proper role of developing countries under the Protocol; (3) what types of carbon sequestration activities should be authorized under the Protocol; and (4) the proper mechanisms for implementing the key flexibility provisions of the Protocol, including developing a compliance system.

Options

Option 1: Develop Streamlined Mechanisms for Emission Trading, Clean Development Mechanism and Joint Implementation Programs

Option 2: Improve National and International Awareness of the Potential Benefits of Renewable Energy and the Opportunities for Promoting Renewables

Renewable energy projects tend to be small relative to conventional fossil fuel-fired power plants. Their small scale makes them extremely sensitive to administrative and other similar costs. Therefore, it is crucial that any emission-trading or other program developed during the international negotiation process be streamlined enough to make participation by small-scale projects feasible and cost effective. During international negotiations, this means the United States and representatives of the renewables industry need to advocate strongly for developing program criteria that recognize, as a matter of course, the obvious environmental benefits of renewables.

More generally, the renewables industry could become more involved in influencing current climate change negotiations. Although participants are generally aware that renewables present a clean alternative to conventional fossil fuel-fired plants, there is a perception that renewables are too limited, in terms of size and geography, to ever serve a large share of the energy market. This perception must be addressed if renewables are to assume a significant role in strategies to reduce emissions of GHG.

Perhaps the chief barrier to boosting renewables at the international level is the sheer unwieldiness of the international negotiation and implementation process. The negotiations involve dozens of committees and hundreds of participants, each with different interests and agendas. Understanding, let alone participating in, the negotiation process is a difficult proposition. Despite these barriers, renewable energy advocates need to be involved in international negotiations and push for appropriate consideration of renewable energy in addressing climate change issues. They also need to be active in building support at the national level, because that is where the programs to reduce GHGs will ultimately be implemented.

Option 3: Adopt a Cap-and-Trade Program for CO_2

As discussed above, Congress has explicitly incorporated the cap-and-trade approach in the acid rain program to curb SO_2 emissions. The cap-and-trade approach has also been incorporated in regulating NO_x emissions. Although there has been resistance to incorporating the same cap-and-trade approach to the control of CO_2 and other GHG emissions, support could be developed over time. The renewable energy industry could play an important role in developing the support in Congress to enact legislation authorizing a cap-and-trade program for CO_2 similar to those being implemented for other pollutants. In the alternative, states could assume responsibility for adopting a similar program.

Observations

This paper presented an overview of the opportunities available under both existing and future clean air programs to promote renewable energy technologies. It also described the barriers to taking advantage of these opportunities. To overcome the barriers, several options were identified in the four program areas covered in this paper. Table 1 summarizes the program options discussed above.

In terms of time horizon, the options can be grouped into short term and longer term (see fourth column of Table 1). In general, short term refers to options that could be implemented in the next three to five years. Options identified as short term generally include those in which there is already significant legislative interest (e.g., reducing the SO_2 cap) or which can be implemented without amending the CAA or international agreements.

The table also distinguishes among options based on whether they require legislative changes or can be implemented administratively. The uncertainty inherent in the legislative process and

international negotiations tend to lengthen the time needed for those programs to be implemented and potential benefits to be realized.

Among the options identified, the following appear to have the greatest potential for promoting renewable energy resources within the context of clean air regulation:[k]

- Tighten the existing SO_2 cap and establish an improved allowance set-aside program to replace the CRER.
- Pursue a national cap-and-trade program for NO_x.
- Encourage renewables under state programs developed under the NO_x SIP Call or Northeast Ozone Transport Commission trading programs.
- Include renewables in emission-trading programs developed to implement national regional haze requirements.
- In the long term, pursue a multi-pollutant-trading program.

Many of these programs could be combined with non-CAA alternatives, such as renewable portfolio standards or system benefits charges to further encourage renewables. It should be noted that these options are deemed best from the perspective of promoting renewable electricity generation, not from the perspective of air quality regulation. They can become the starting points for discussions with air quality regulators and others.

Finally, the final report on the project has been published. As a logical next step, it may be useful to subject the options identified in the report to a broader review through further analysis, workshops, and wider dissemination of the final report. In addition, it may be useful to consider more broadly the coordination between, or integration of, environmental policies and energy policies both generally and in relation to renewable energy. Whatever approach is taken, it is important that developers and advocates of renewable energy actively debate the issues and offer their views for consideration.

[k] Some of the options listed below represent a combination of two or more individual options identified in the discussion above.

Table 1: Comparison of Options by Approach, Time Horizon, and Legislative Requirement

Options	Targeted Pollutant/ Program Area	Approach	Short / Longer Term	Legislation Required?
Tighten the existing SO_2 cap.	SO_2/ Acid Rain	Cap-and-trade	Short term	Yes
Establish an improved allowance set-aside program for renewables to replace the CRER.	SO_2/ Acid Rain	Cap-and-trade with RE set-aside	Short term	Yes
Encourage renewables under existing programs established by the Northeast Ozone Transport Region under its existing MOU, under the NO_x SIP Call, or Section 126 rulemaking.	NO_x / Ozone control	Implementing existing program	Short term	No
Include a renewable set-aside or other renewable incentives as part of upcoming guidance on the emission-trading alternative to BART under regional haze program.	Regional haze	Cap-and-trade with RE set-aside	Short term	No
Improve national and international awareness of the potential benefits of renewable energy and the opportunities for promoting renewables through various programs such as RPS.	CO_2 / General	Information & Education	Short term	No
Establish a national or regional NO_x cap-and-trade system with a renewable set aside.	NO_x/Ozone Control	Cap-and-trade with RE set-aside	Longer term	Yes
Adopt state or federal programs specifically targeted at controlling PM through cap-and-trade programs.	PM/Regional haze	Cap-and-trade	Longer term	Yes
Pursue backstop-trading program under the GCVTC portion of the regional haze regulations.	SO_2/Regional haze	Cap-and-trade with RE set-aside	Longer term	No
Adopt a cap-and-trade program for CO_2.	CO_2 / Climate change	Cap-and-trade	Longer term	Yes
Develop streamlined mechanisms for CO_2 emission trading, CDM, and JI.	CO_2 / Climate Change	Implementation mechanism	Longer term	Yes
Phase out the existing allowance allocation program in favor of a renewable energy allocation based on generation in the SO_2 program.	SO_2; potentially all	Output-based allowance allocation	Longer term	Yes
Phase out the existing allowance allocation program in favor of an allowance auction system.	SO_2; potentially all	Auction	Longer term	Yes
Combine an improved SO_2 allowance allocation for renewables with a system for other pollutants emitted from power plants.	SO_2; potentially all	Multi-pollutant program	Longer term	Yes
Combine an improved NO_x allowance allocation for renewables with a system for other pollutants emitted from power plants.	NO_x; potentially all	Multi-pollutant program	Longer term	Yes

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13. ABSTRACT *(Maximum 200 words)*
This paper examines the opportunities, obstacles, and potential options to promote renewable energy under the CAA and related programs. It deals, in sequence, with the regulation of SO_2, NO_x, regional haze/particulate matter, and CO_2. For each pollutant, the paper discusses the opportunities, barriers, and options for boosting renewables under the CAA. It concludes by comparing the options discussed. The paper is based on a project on environmental regulation and renewable energy in electricity generation conducted by the National Renewable Energy Laboratory for the Office of Power Technologies, Office of Energy Efficiency and Renewable Energy, U.S. Department of Energy.

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