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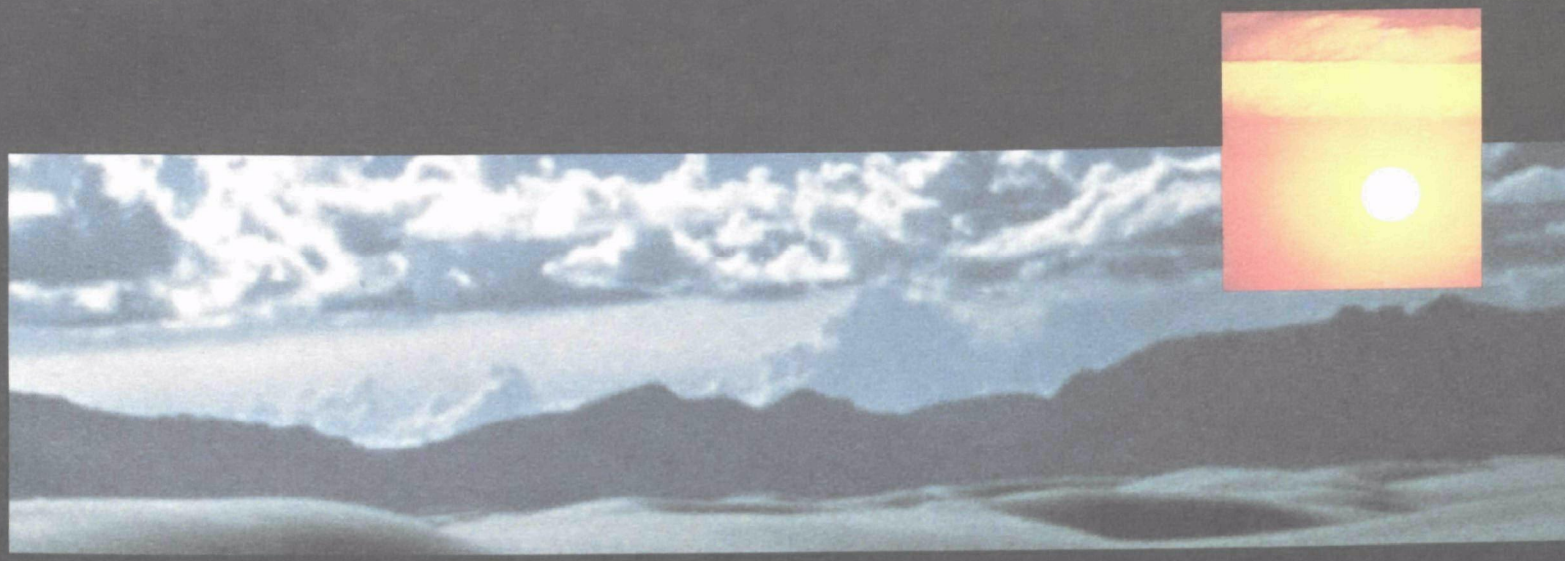
Energy Efficiency and Renewable Energy

Opportunities from Title IV of the Clean Air Act



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ACID RAIN
PROGRAM

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ENERGY EFFICIENCY AND RENEWABLE ENERGY:

Opportunities from Title IV of the Clean Air Act

ACID RAIN DIVISION
US ENVIRONMENTAL PROTECTION AGENCY
FEBRUARY 1994

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Executive Summary

The 1990 Clean Air Act Amendments provide a significant opportunity for energy efficiency and renewable energy to play a cost-effective role in an electric utility's resource mix. Through an innovative system of tradeable emission allowances, Title IV of the Act calls for a 10 million ton reduction in national SO_2 emissions. To encourage pollution prevention, Title IV includes three incentives to promote the use of efficiency and renewable energy.

The Incentives

The three incentives to encourage efficiency and renewable energy are:

1. Avoided emissions;

2. Conservation and Renewable Energy Reserve; and

3. The Reduced Utilization provision.

Avoided emissions is perhaps the most lucrative of the three incentives; each ton of SO_2 avoided through efficiency and/or renewable energy saves one emission allowance. Thus, the avoided emissions incentive allows a utility to save emission allowances at the utility's own rate of emissions. Furthermore, the avoided emissions incentive is quite simple to implement; no reporting, applications or verification are required.

The Conservation and Renewable Energy Reserve is a special bonus pool of 300,000 allowances set aside to reward new initiatives in demand-side efficiency and renewable energy. For every 500 MWh of energy saved through demand-side efficiency or generated through renewable energy, a utility earns one allowance from the Reserve. A utility is eligible for Reserve allowances from January 1, 1992 until the utility enters the Acid Rain Program.

Reduced utilization of an affected unit is one compliance option. During Phase I, though, a utility may not reduce generation below its baseline merely by shifting generation to non-affected units, unless such shifts are offset by efficiency or renewable energy. Thus, efficiency and renewable energy resources can help avoid the loss of emission allowances and the imposition of other penalties.

In general, the value of these incentives will be the number of allowances generated or saved multiplied by the market price of an SO_2 emission allowance.

SO_2 Compliance Strategies

Efficiency and renewable energy can be cost-effective components to an integrated compliance strategy. Efficiency and renewable energy can play a significant role by:

- Complementing or offsetting the use of other compliance strategies such as fuel-switching;

- Delaying the use of expensive alternative strategies such as scrubbing;

- Helping to avoid penalties associated with noncompliance; and
- Increasing revenues through the sale of extra allowances.

The usefulness of the three incentives on SO_2 compliance depends upon each utility's own circumstances. Utilities that currently emit high levels of SO_2 can benefit significantly from the incentives. However, even utilities already in compliance can benefit from the revenues generated by extra allowances.

Resource Cost-Effectiveness

Because emission allowances place an economic value on SO_2 emissions, a utility's avoided costs will change as a result of Title IV. In turn, increases in avoided costs due to avoided SO_2 costs will increase:

- The number of efficiency measures and renewable energy options that are cost-effective;
- The penetration of efficiency programs and the size of renewable energy projects; and
- The project economics for energy-service companies and independent power producers.

Thus, program design and screening procedures for demand-side efficiency programs, supply-side efficiency programs, and renewable energy projects should incorporate avoided SO_2 costs. Likewise, bidding and dispatch processes should include these costs.

Beyond SO_2

Efficiency and renewable energy not only help utilities avoid SO_2 emissions but other pollutants as well, including NOx, CO_2, toxics, and particulates. The methodologies for incorporating SO_2 costs into compliance planning and resource cost-effectiveness can apply to other pollutants as trading markets emerge. In some regions, where ground-level ozone is a problem, trading systems for NOx are being developed.

Even when a pollutant is not presently regulated, it may be cost-effective to consider the pollutant when formulating SO_2 strategies. The addition of expensive control technologies for each pollutant can be considerably more costly than addressing all pollutants simultaneously through efficiency and renewable energy. Thus, efficiency and renewable energy resources can help a utility minimize the risk of future environmental regulations.

Integrated Resource Planning

The market-based benefits of the Clean Air Act incentives are ideal inputs for integrated resource planning. By incorporating these benefits into the planning process the true economic competitiveness of energy efficiency and renewable energy is more fully realized.

Introduction

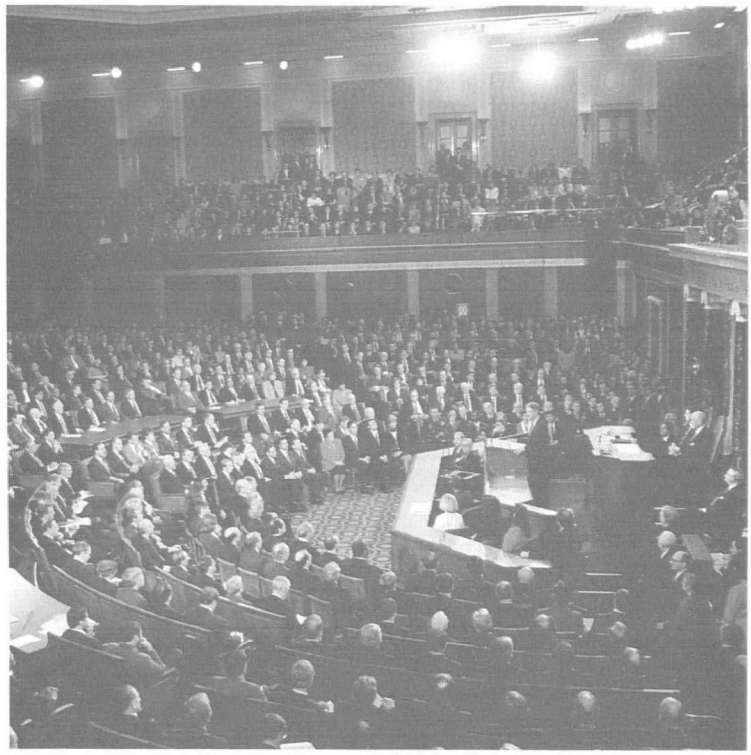


Photo courtesy of U.S. House of Representatives

The Clean Air Act Amendments of 1990 have given energy efficiency and renewable energy resources an added quantifiable value. The purpose of this handbook is to assist in quantifying the incentives from Title IV of the Clean Air Act.

Energy efficiency and renewable energy are valued resources in meeting future energy demands. The Clean Air Act Amendments of 1990 increased the attractiveness of these resources through an innovative system of tradeable emission allowances. This handbook quantifies the added value energy efficiency and renewable energy bring to an electric utility based upon the incentives in Title IV of the Clean Air Act.

Clean Air Act Goals and Incentives

When the United States Congress embarked upon the Clean Air Act Amendments, several goals were paramount. The primary goals for Title IV, the Acid Rain Program, are:

- Achieve significant environmental benefits by reducing emissions of sulfur dioxide and nitrogen oxide;
- Reduce these emissions at the lowest cost to society; and
- Encourage pollution prevention through efficiency and renewable energy.

The resulting legislation called for a 10 million ton emission reduction in sulfur dioxide and a 2 million ton reduction in nitrogen oxides.[1] To promote pollution prevention the program includes three incentives for energy efficiency and renewable energy. These three incentives are:

1. Allowance savings from avoided emissions;
2. Bonus allowances from the Conservation and Renewable Energy Reserve; and
3. Generation shifts away from high emitting plants by use of the Reduced Utilization provision.

Handbook Contents and Structure

This handbook will describe how each of the three incentives work and the potential impact on environmental compliance strategies and resource cost-effectiveness. The varying implications for demand-side management, supply-side efficiency improvements, and renewable energy technologies are addressed.

The essentials of quantifying Clean Air Act benefits are presented through examples and step-by-step work sheets. The examples are based upon real data from utilities with differing Clean Air Act compliance needs. The data requirements and calculation methodologies are illustrated through these examples.

The handbook is organized into five parts. Part I provides an overview of Title IV and tradeable emission allowances. Part II describes each of the three incentives for energy efficiency and renewable energy in detail. Part III explains the impact of the incentives on SO_2 compliance strategies. Part IV explains the impact of the incentives on other applications affecting energy efficiency and renewable energy, including program design and screening, bidding, and dispatch. Part V applies these methodologies to pollutants other than SO_2.

Handbook Goals

This handbook will assist in understanding the relationship between the Clean Air Act and the cost-effectiveness of energy efficiency and renewable energy. A number of groups will find this information pertinent, including:

- ❑ Utility regulators;
- ❑ Utility environmental compliance planners;
- ❑ Utility resource planners;
- ❑ Energy efficiency manufacturers and service providers;
- ❑ Renewable energy manufacturers and developers;
- ❑ Consultants;
- ❑ Environmental organizations; and
- ❑ Consumer advocacy groups.

Through the market-based allowance trading system of the Clean Air Act, reductions in SO_2 emissions have a real value to electric utilities. Allowance trading provides the incentive for utilities to pursue energy efficiency and renewable energy technologies, and to minimize costs by doing so.

The extent to which the Clean Air Act incentives affect the financial outlook of energy efficiency and renewable energy will depend upon each utility's own circumstances. However, all utilities should seriously consider these opportunities. The real, quantifiable value of the Clean Air Act incentives can be key to maximizing a utility's overall cost-effectiveness in serving its customers and protecting the environment.

Part I

The Acid Rain Program

Photo courtesy of Chicago Board of Trade

Using market-based mechanisms to achieve environmental goals is becoming increasingly common. The market trading of SO_2 emission allowances, as provided by the Clean Air Act, serves to benefit energy efficiency and renewable energy.

This part discusses the following topics:

A. Overview of EPA's Acid Rain Program
B. The Allowance Trading Market
C. Environmental Benefits

A. Overview of the Acid Rain Program

Through Title IV of the Clean Air Act Amendments, Congress established the Acid Rain Program. The program seeks to significantly reduce emissions of SO_2 and NO_x, the primary causes of acid rain. To achieve this goal at the lowest cost to society, the program employs an innovative market-based approach for controlling emissions. In addition, the program encourages pollution prevention through efficiency and renewable energy.

Title IV sets as its primary goal the reduction of annual SO_2 emissions by 10 million tons below the 1980 level. These reductions will be achieved over two phases. Phase I begins in 1995 and affects 110 mostly coal-burning electric utility plants located in 21 eastern and midwestern states. Phase II, which begins in the year 2000, tightens the Phase I limits and expands the scope of the program to include most electric utility plants over 25 MW.

The Acid Rain Program creates a new tradeable commodity, the SO_2 emission allowance. Each allowance represents an authorization to emit one ton of SO_2 (i.e., a unit that emits 5,000 tons of SO_2 must hold at least 5,000 allowances that are usable that year). Each affected source is allocated a specific number of allowances for Phase I and Phase II based on past emissions rates and utilization.[2] Once allocated, allowances may be bought, sold, traded, or banked for use in future years. At the end of each compliance year, a utility must retire one allowance for each ton of SO_2 emitted in the preceding year. Holding an insufficient amount of allowances can result in a $2,000 per ton fee for non-compliance.

The tradeable allowance system will help utilities achieve SO_2 reductions at the lowest possible cost by allowing the utilities to choose the most cost-effective compliance strategy. Compliance strategies can include purchasing allowances from other utilities, switching to lower-sulfur fuels, installing scrubbers, and/or implementing efficiency and renewable energy resources. The utility decides which compliance strategies best meets its needs.

Energy efficiency measures and renewable energy generation can be an important part of a compliance plan for several reasons. Efficiency and renewable energy resources not only create allowances for the utility through the Conservation and Renewable Energy Reserve, but they also *avoid* emissions for which the utility would otherwise need to surrender allowances.

The following table defines some terms commonly used to evaluate the role of efficiency and renewable energy in meeting Title IV requirements.

SO_2 Allowance Terminology

Earned Allowance:

Allowance gained by utility through the Conservation and Renewable Energy Reserve.

Saved Allowance:

Allowance that utility is not required to surrender to EPA, due to avoiding the emission of one ton of SO_2 at an affected unit. Avoided emissions and Reduced Utilization result in saved allowances.

Allowance Balance:

Cumulative balance of allowances in a utility's allowance account, which can be thought of as a "savings" account. Positive annual balances will be added ("deposited") to the account; negative annual balances will be subtracted ("withdrawn"). Also called allowance reserve margin.

Banked Allowances:

Unsurrendered and unsold allowances held by a utility in excess of compliance requirements.

B. The Allowance Trading Market

1. Overview

A key factor in evaluating the impact of the Clean Air Act incentives will be the market price of an emission allowance. The allowance price will determine the degree to which efficiency and renewable energy resources add value to the utility.

The allowance price is of importance to utilities in a variety of compliance situations. For utilities that are still in the process of formulating compliance strategies, allowance price assumptions are critical to determining the relative cost-effectiveness of each compliance option. The cost-effectiveness of efficiency and renewable energy versus the other options will vary depending upon the market price. For utilities already holding excess allowances due to other compliance actions, the allowance price will indicate the additional revenue that may be gained from efficiency and renewable energy. For utilities considering purchasing allowances as a compliance strategy, the market price will directly determine compliance costs.

2. Market Estimates

Each year EPA holds an auction and direct sale of a small portion of allowances (2.8 percent) reserved from the total allowance allocation. The auctions are intended to help signal price

information to the market early in the program and to provide a public source of allowances for new utilities that are not allocated allowances. Utilities, environmental groups, allowance brokers can participate in the EPA auctions. The initial auctions are being administered by the Chicago Board of Trade.

The 1993 EPA auction yielded the first recorded values for the allowances. Prices for allowances for use beginning in 1995 ranged from $131 to $450 with an average of $156 per allowance. Prices for allowances for use beginning in 2000 ranged from $122 to $310 with an average of $136 per allowance.

However, these initial results may not represent actual market values. First, EPA did not set a minimum price on the allowances. Thus, the resulting price did not necessarily represent the value at which allowance holders are willing to sell. Second, allowance trading is a relatively new instrument; market activity and expertise in this area will continue to evolve. Third, the auction sales were paid in 1993 dollars while the allowances are for use starting in 1995 and 2000. Thus, the auction results represent the net present value of some higher future allowance price.

Price signals are entering the market through other means as well. Several private trades have taken place, although the details of these trades are not always made public by the participants. Several brokerage firms and trading exchanges are offering such services as on-line trades, SO_2 futures trading, and private auctions. Specialty consulting firms are also offering price information services. As actual compliance dates near, a more certain allowance market should develop.

A recent report issued by the Electric Power Research Institute (EPRI) indicates that allowance prices could rise from $250 per allowance in 1995 to $480 per allowance in 2007.[3] These values are in 1992 dollars. EPRI's projections are based upon research of likely utility compliance actions. Table I-1 summarizes EPRI's findings for the expected allowance price as well as the estimated price floor and ceiling.

3. Handbook Assumptions

Unless otherwise stated, the examples presented in this Handbook are based upon a *conservative* allowance price of $200 per allowance or the $250 EPRI estimate for 1995 allowances. While these examples often demonstrate the substantial financial benefits of efficiency and renewable energy, these benefits will be even greater at a higher allowance price. The cost-effectiveness of efficiency and renewable energy resources will increase as the cost of emitting SO_2 increases.

C. Environmental Benefits

1. The Effects of Acid Rain

Acid rain and the emissions that cause it damage waters and forests, endanger animal species, accelerate the decay of buildings and monuments, and impair public health. Acid rain has been the primary cause of the acidification of 1,350 streams in the Mid-Atlantic highlands, 90% of the streams in the New Jersey Pine Barrens, and a large number of lakes in the Adirondacks. The Canadian government estimates

Table I-1
Projected Allowance Prices[a]

	1995	2000	2003	2007
Estimated Floor	190	250	250	200
Expected Price	250	340	400	480
Estimated Ceiling	320	430	510	650

[a] In 1992 dollars/ton paid in the year indicated. The expected price is a market clearing price that assumes the continued operation of most fossil fuel units.

Source: EPRI

that 14,000 lakes in eastern Canada are acidic. In many sensitive lakes and streams acidification has completely eradicated fish species, leaving these water bodies barren of life. If acidic deposition levels were to remain constant over the next 50 years, the acidification rate of lakes in the Adirondacks is expected to rise by 50 percent or more.

Acid rain also degrades forests, particularly high-elevation spruce trees that populate the Appalachian Mountains, by increasing the spruce's vulnerability to winter injury. This deterioration of forests affects important natural areas such as the Shenandoah and Great Smoky Mountain National Parks. Furthermore, long-term contamination of the sensitive soils is likely to have already occurred. Acid rain moves through soils, stripping away vital plant nutrients through chemical reactions, and thus poses a threat to future forest growth.

Sulfur dioxide emissions in the atmosphere are responsible for over 50% of the visibility reduction in the eastern part of the United States. The resulting haze from sulfur dioxide emissions has impaired enjoyment of many national parks across the country, including such parks as the Grand Canyon and Shenandoah. Acid rain also corrodes metals, stone, and paint resulting in the deterioration of precious cultural materials, such as statues and monuments. Dry deposition of acidic compounds can also dirty buildings and other structures. The maintenance and repair costs associated with acid rain are extremely high. Given the large number of buildings affected by acidic deposition, even a small impact on maintenance costs translates into a very large savings to society.

Finally, recent studies have pointed to increased health risks from particulate matter, which includes sulfates and other pollutants emitted during the combustion of fossil fuels. A recent study by Harvard University's School of

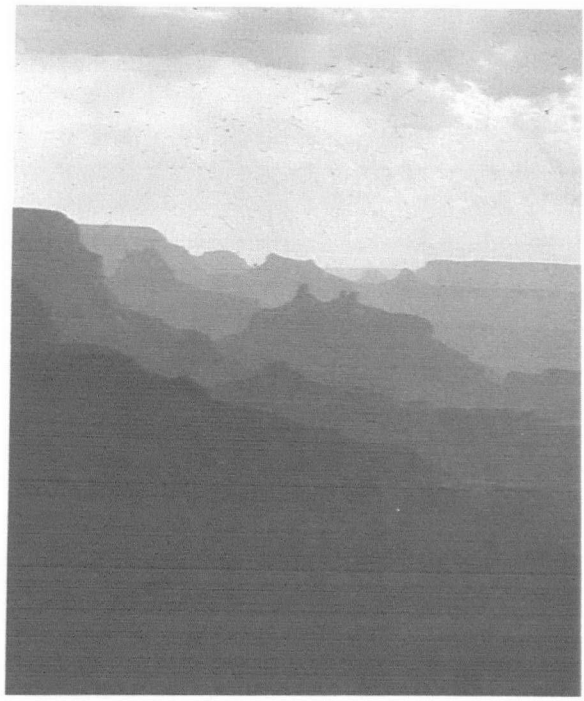


Photo courtesy of U.S. Dept. of Interior

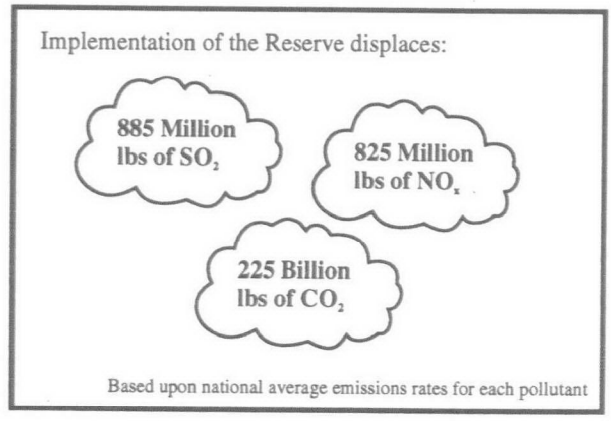
Public Health linked these emissions to higher mortality rates. Preliminary results of another Harvard University study of 24 North American cities showed a strong statistical association between decreased lung function in children and long-term exposures to ambient acidic aerosols. EPA is in the process of evaluating the need for tighter regulations on emissions of particulate matter.

Based on concerns about the various effects of acid rain on humans, animals and the environment, Congress mandated aggressive SO_2 reductions under the Clean Air Act Amendments. The Acid Rain Program promises to confer great benefits on human health and the environment. The 10 million-ton reduction in SO_2 emissions should significantly decrease acidification of water bodies and forest soils and allow many of these systems time to recover. Visibility is expected to increase by 30% or more in the eastern United States, and the lifespans of buildings and monuments should improve. Finally, the SO_2 reductions will make the air healthier to breathe.

2. Environmental Benefits from the Clean Air Act Incentives

Energy efficiency and renewable energy can play a crucial role in SO_2 emissions reductions. Pollution prevention through efficiency and renewable energy helps combat not only acid rain, but other environmental harms as well, including global warming and urban smog. In addition to SO_2, efficiency and renewable energy resources help prevent emissions of CO_2, NO_x, toxics, and particulates. These resources also avoid the production of ash and scrubber sludge.

The environmental benefits from just one of the Title IV incentives, the Conservation and Renewable Energy Reserve, are substantial. The 300,000 allowances in the Reserve represent a conversion of 150 billion kWh to efficiency or renewable energy. The following graphic illustrates the net pollution displaced by the implementation of the Reserve.



The CO_2 reductions from the Reserve are equivalent to taking 21 million cars off the road each year or the planting of 43.5 million acres of trees. These reductions are based upon national averages for each pollutant's emissions rate.[4] The actual amount of emissions offset will depend upon each utility's marginal rate of emissions.

The emissions offset in the illustration above is only a small portion of the total emissions avoided by the Title IV incentives. The environmental benefits of efficiency and renewable energy persist as long as these resources function. Through the use of efficiency and renewable energy resources, electric utilities are able to demonstrate concern for the environment and project a positive image to the community at large.

Part II

The Incentives: Clean Air Act Opportunities

Photo courtesy of Ed Linton

The number of allowances that can be gained from avoided emissions, the Reserve, and Reduced Utilization will vary with each utility's unique circumstances. However, each utility should calculate the value the Clean Air Act incentives add to efficiency and renewable energy resources.

This part describes the three Clean Air Act incentives to encourage energy efficiency and renewable energy; data needs are identified and work sheets are provided to help the analyst determine each incentive's added value. The three incentives from Title IV of the Clean Air Act are:

A. Avoided Emissions
B. Conservation and Renewable Energy Reserve
C. Reduced Utilization

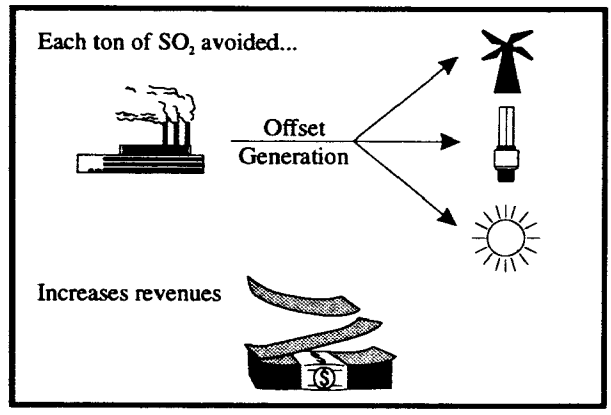
A. Avoided Emissions

1. Overview

Each time a utility emits a ton of SO_2, the utility has expended an emission allowance. Given the market value of each emission allowance, the utility has thus also expended a financial resource. Simply avoiding the emission of SO_2 through efficiency and renewable energy is perhaps the most lucrative of the Title IV incentives.

Each ton of SO_2 avoided through the use of energy efficiency and renewable energy means one less allowance must be surrendered to comply with Title IV. Both demand-side and supply-side efficiency programs will create value for the utility through avoided emissions. Any energy generation type that reduces SO_2 emissions will likewise support avoided emissions. The avoided transmission and distribution losses associated with an efficiency and/or renewable energy program will also benefit the utility.

The result is an allowance that can be used for current compliance, "banked" for future use, or sold. The utility saves these allowances at the average emission rate of the utility's units affected by Title IV. For utilities currently emitting high rates of SO_2, avoided emissions can thus be particularly valuable.



2. Eligibility

Avoided emissions are relevant during both Phase I and Phase II. To save allowances, the avoided emissions must occur at units affected by Title IV. During Phase II, virtually all fossil-fueled units are affected. Thus, avoided emissions may be particularly beneficial after Phase II begins on January 1, 2000.

3. Verification/Application Procedures

Avoiding emissions through efficiency and renewable energy is the simplest of the incentives to implement. The utility achieves the benefits of avoided emissions automatically. No forms or applications need to be submitted to EPA or any other governmental entity. No verification is required to prove the efficiency or renewable energy resource is in place. The lack of paperwork further enhances the cost-effectiveness of this incentive. The indirect and overhead costs normally associated with regulatory requirements are avoided.

The benefits from avoided emissions reach far beyond Clean Air Act compliance. For utilities that are already in compliance, the extra allowances can be sold to further lower overall costs. Thus, avoided emissions are an easy way to not only save a substantial number allowances but to minimize utility costs as well.

4. Evaluating the Impact of Avoided Emissions

To understand the potential impact of avoided emissions the utility should model its system with and without the efficiency and renewable energy programs in place. "Production-simulation" models are useful for this purpose. Production-simulation models simulate system operation to determine energy production costs, dispatch order, generation and total emissions. Different system specifications are modeled and compared to yield estimates of avoided emissions.

Examples of commercially available production-simulation models include ENPRO© and PROMOD©. Appendix A includes information on the necessary input data and procedures for using a production-simulation model.

The following work sheet leads the analyst through the steps needed to assess the value of avoiding SO_2 emissions through efficiency and renewable energy. Complete the following steps for each year the utility has units affected by Title IV. Phase I units are affected from January 1, 1995 forward. Phase II units, which include most fossil-fired units, are affected from January 1, 2000 forward.

Work Sheet No. 1
Evaluating the Impact of Avoided Emissions

STEP 1:

Identify planned or potential efficiency and renewable energy programs and quantify program effects on peak demand (MW) and energy (MWh).

Tons

STEP 2:

Run production-simulation model with and without the efficiency and/or renewable energy programs in place. Determine the level of SO_2 emissions for each scenario.

2a. Estimated tons of SO_2 without efficiency/renewable program(s)

Tons

2b. Estimated tons of SO_2 with efficiency/renewable program(s)

Tons

The model will also allow determination of production costs, total and unit-by-unit generation levels (MWh), and peak demand (MW). These data are useful to ensure that the outputs are reasonable and to assist the analyst in understanding model runs.

STEP 3:

Determine the avoided emissions due to the efficiency and renewable energy programs. Subtract the result in 2b from the result in 2a. This difference in tons represents the allowances saved by avoided emissions.

Allowances

STEP 4:

Multiply the number of allowances saved in step 3 by the market value for emission allowances. This result is the value added by the avoided emissions incentive.

$

B. Conservation and Renewable Energy Reserve

1. Overview

The Reserve is a special bonus pool of 300,000 allowances that Congress set aside to award utilities undertaking new initiatives in efficiency and renewable energy. For every 500 MWh of energy saved through demand-side efficiency or generated through renewable energy, a utility earns one allowance from the Reserve. Reserve allowances may be used for current compliance, banked for future use, or sold.

A utility can apply for Reserve allowances for efficiency measures and renewable energy generation brought into operation on or after January 1, 1992. Energy efficiency measures may be installed under a program that existed before January 1, 1992 as long as the measures themselves were installed after this date. Efficiency programs are restricted to demand-side programs only; supply-side efficiency measures cannot be claimed for Reserve credit. Renewable energy programs qualifying for the Reserve include biomass, geothermal, solar, and wind energy resources. Transmission and distribution losses avoided by the programs may also be credited with Reserve allowances.

The Reserve is an incentive for utilities to set up efficiency measures and renewable generation years before compliance deadlines. Phase I utilities may earn Reserve allowances from January 1, 1992 until these utilities enter the Acid Rain Program on January 1, 1995. Phase II utilities may earn Reserve allowances from January 1, 1992 until these utilities enter the Acid Rain Program on January 1, 2000. Thus, the Reserve encourages utilities to get a head start on meeting the Acid Rain Program's emissions standards.

2. Eligibility Requirements

To qualify for the Reserve the applicant must meet the following requirements (also see 40 CFR 73.81 and 73.82):

- ✓ Applicant must sell electricity (utility or independent power producer).
- ✓ Applicant or applicant's holding company must own or operate, in whole or in part, a Phase I or Phase II unit.
- ✓ Applicant must be subject to a least cost plan or planning process that is approved or accepted by the applicant's ratemaking entity. The least cost plan or planning process must meet the following requirements: (1) public participation; (2) evaluation of a full range of resource options; (3) treatment of supply-side and demand-side resources on a consistent and integrated basis; (4) accounting for system operation and risk factors; and (5) implementation of least-cost resources.
- ✓ Investor-owned utilities applying for credit from efficiency programs must be subject to a rate making process that provides for "net income neutrality." This means the utility's rate making

entity adjusts the utility's electric rate for lost sales due to the efficiency program. Applications for net income neutrality must be certified by the Department of Energy.

3. Verification

To receive the Reserve allowances, the applicant must be able to verify to EPA that the efficiency savings or renewable energy generation did occur. Renewable energy generation is verified simply by submitting plant records of net energy generation.

For demand-side efficiency programs, utilities follow one of two verification paths. If a utility is state-rate regulated and the rate making entity uses a performance-based rate adjustment, then the utility submits verification to the state for approval. Otherwise the utility must submit verification to EPA and is encouraged to use EPA's *Conservation Verification Protocols*[5] as a guide to good and accurate verification. Instructions and forms for these Protocols are found in the *User's Guide to the Conservation Verification Protocols.*[6]

4. Application Procedures

Figure II-1 outlines the Reserve application procedures. To apply for Reserve allowances, the applicant must submit a "Conservation/Renewable Energy Reserve" form to EPA. This application is a simple two page form. A copy of this form is included in Appendix B, along with the relevant instructions.

If the applicant is applying for allowances based upon an efficiency program and is an investor-owned utility, the utility must also be certified for "net-income neutrality" by the Department of Energy.[7]

5. Evaluating the Impact of the Reserve

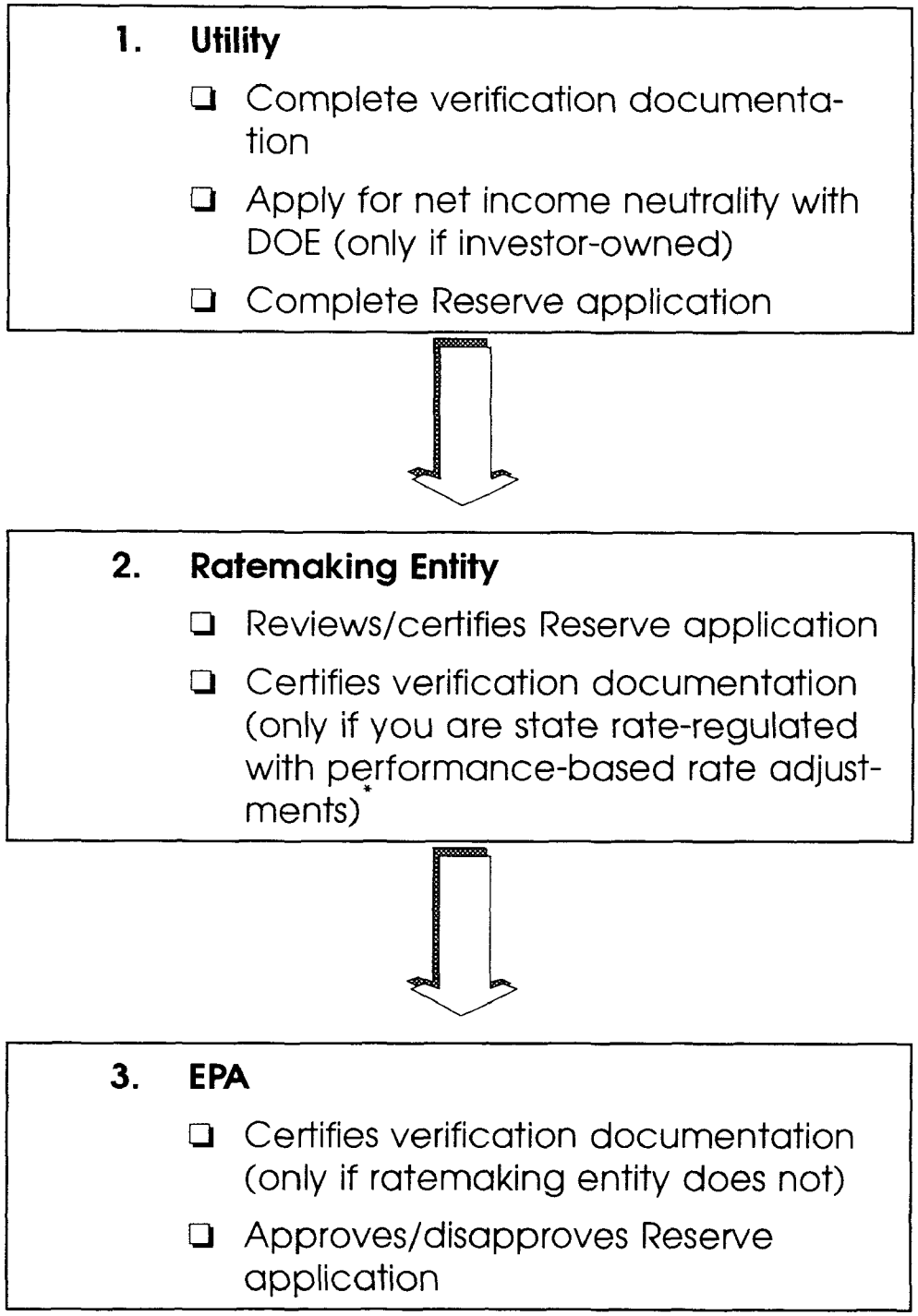
Estimating the impact of the Reserve allowances is a simple process. The rate at which the allowances are earned is fixed at one allowance for every 500 MWh of qualified efficiency savings or renewable energy generation. The primary data needs to estimate the Reserve's impact are:

- The amount of savings from qualified demand-side efficiency measures and the amount of generation from qualified renewable energy programs; and
- The market value for an SO_2 emission allowance.

In addition to determining the value of planned efficiency and renewable energy programs, the analyst should also examine the impact of expanded efforts. The added value given by the Reserve may mean a more aggressive program is the most cost-effective. The Reserve allowances may also change the timing of such programs.

The following work sheet leads the analyst through the steps necessary to assess the value of the Reserve allowances. Complete the following steps for each year the utility is eligible for the Reserve. Phase I utilities are eligible from January 1, 1992 until January 1, 1995. Phase II utilities are eligible from January 1, 1992 until January 1, 2000.

Figure II-1
Reserve Application Procedures



* See 40 CFR 73.82(c)

UTILITY PROFILE
City of Austin, Texas

The City of Austin is one of a growing number of municipalities where the generation and conservation of Electrical Energy are managed by separate departments within municipal government. The Electric Utility Department provides Generation and billing services, while the Environmental and Conservation Services Department (ECSD) provides Conservation and Energy Services to the citizens of Austin.

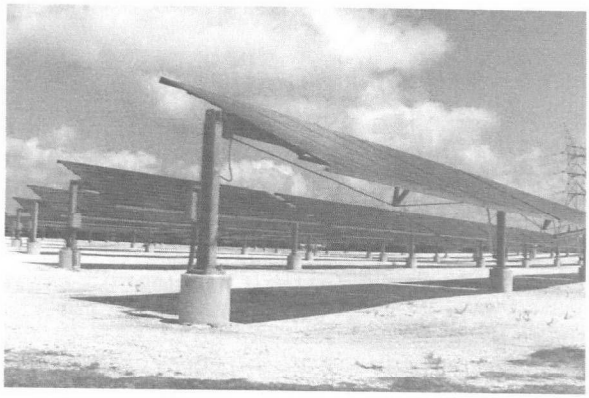
The Environmental and Conservation Services Department provides 14 individual programs to commercial and residential customers, and has provided the Electric Utility Department with more than 200 MW of generation capacity deferred since 1982. This represents a reduction of 11% in system capacity requirements.

ESCD's programs are designed primarily to promote maximum efficiency in Austin's energy and environmental resources. Current programs include: residential loan and rebate programs, the "Energy Star" and "Green Builder" new home rating programs, commercial and municipal energy programs, multi-family programs, a home weatherization program for low-income, elderly and disabled customers, and an air conditioning rebate program. ECSD is considering refrigerator disposal, residential lighting, and commercial duct repair programs. The current Demand-Side Management Program forecast for the City of Austin estimates a savings of 270 MW and 1267 GWh during the next twenty years (capacity savings include a system reserve margin of 20%).

As a result of current programs, the City is forecasting substantial emission reductions. ECSD has developed a sophisticated model based on the EPA's ISCLT model which predicts the dispersion, fall, absorption, and decomposition rates of several pollutants. Analyses with this model indicate that at the current level of commitment to DSM, the City will reduce the emission of CO_2 by 27,000 tons, SO_2 by 20 tons, Nox by 54 tons, CO by 13 tons, and Total Suspended Particulates by 2 tons (all values are yearly incremental savings). Environmental benefits computed by the model are monetized at the local, long-range and global levels, with savings of at least $20.5M for each $10M invested in conservation.

ECSD also counts economic impacts due to DSM in its cost-effectiveness criteria. As a result, a projected investment (by the City) of $10M per year will generate a net economic benefit of $3.7M per year and the creation of 137 jobs.

The Electric Utility Department has made a significant investment in renewable energy resources, particularly solar voltaic systems. One such project is the 300 KW (alternating current) generating facility at the Decker Power Plant. Analysis of the first year's operation determined that reliability exceeded 99%, a yearly capacity factor of 22%, but a summer on-peak capacity factor of 55%. The yearly cost savings attributed to fuel were $7800, which



Austin Photovoltaic System

translates to $0.02 per kWh. The plant, dedicated on December 5, 1988 has been operating at or near design conditions since that date.

Based on the sustainable DSM programs which were implemented in 1992, the City of Austin received 18 SO_2 emission allowances from the Conservation and Renewable Energy Reserve. Austin was the first municipal utility to receive Reserve allowances from the EPA.

Work Sheet No. 2
Evaluating the Impact of the Reserve

STEP 1:

Determine if the applicant qualifies for Reserve allowances. Note the eligibility requirements listed above (or see 40 CFR 73.81 and 73.82). If the applicant and its programs qualify, proceed to step 2.

STEP 2:

Determine the total amount of system-wide savings (MWh) from qualified demand-side efficiency programs and the total generation (MWh) from qualified renewable energy generation. Add these two values together. *Note that the demand-side efficiency measures and renewable energy generation must have become operational on or after January 1, 1992 to qualify, and must be verified.*

	MWh

STEP 3:

Divide the result in step 2 by 500 MWh/allowance. This result is the number of allowances to be received from the Reserve.

	Allowances

STEP 4:

Multiply the number of Reserve allowances earned in step 3 by the market value for emission allowances. This result is the value added by demand-side efficiency measures and renewable energy generation from the Reserve. Repeat steps 1 - 4 for each year the applicant is eligible for the Reserve.

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C. Reduced Utilization[8]

1. Overview

The Reduced Utilization provision prevents anticipated Phase I emission reductions from being eroded if generation is shifted away from a Phase I plant to unaffected SO_2 emitting facilities. Such load shifting would result in increased emissions at Phase II plants or unregulated sources.

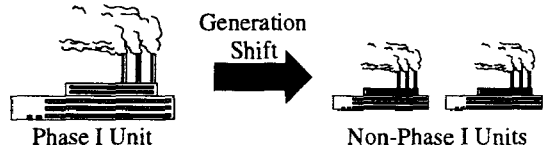
The Reduced Utilization provision requires utilities either to specify the unit or units which will provide the compensating generation (and make them affected Phase I units) or to surrender allowances for shifting generation below its Phase I units' 1985-87 baseline. The allowances are surrendered at the average emission rate of the system's Phase II units.[9]

However, the provision also allows energy efficiency and renewable energy to offset these shifts and thus avoid the loss of allowances. To avoid surrendering allowances, the utility may:

1. Shift to a sulfur-free generator;[10]
2. Offset with demand-side efficiency measures; or
3. Offset with supply-side efficiency measures.

Efficiency and renewable energy resources permit utilities to reduce the usage of Phase I plants without the requirement to designate a compensating unit or to give up additional allowances.

Reduced Utilization provision prevents utilities from shifting generation below the system's Phase I baseline.



Unless load shifts are offset by efficiency or renewable energy.

A further advantage of using efficiency or renewable energy in Reduced Utilization is the flexibility of where the measure or generation occurs. Offsetting energy efficiency measures may come from anywhere within the utility system. Offsetting renewable energy generation may even be purchased from outside of the utility system. Thus, a Phase I unit may be credited with the savings or generation from a source far from the unit itself.

2. Eligibility Requirements

The Reduced Utilization provision is applicable only to electric utilities with Phase I-affected units. Unlike the Conservation and Renewable Energy Reserve, utilities may use both demand-side measures *and* supply-side (i.e., power generation, transmission, or distribution) efficiency measures. Utilities

may receive credit for efficiency measures installed as early as January 1, 1988, as long as the utility verifies that the savings persist during the period of 1995-1999.

3. Verification

Annual verification of energy savings or renewable energy generation is required to receive credit under the Reduced Utilization provision. The renewable energy generation may be verified with plant records of net energy generation. Demand-side and supply-side energy efficiency measures may be verified by following appropriate verification procedures. These verification procedures may be those prescribed by the utility's ratemaking entity or the procedures outlined in EPA's Conservation Verification Protocols.[11]

4. Application Procedures

A Reduced Utilization plan must be filed with EPA by November 1 of the year in which reduced utilization occurs. An initial estimate of energy conservation savings must be filed in the annual compliance certification report by March 1 of the following year. The unit's designated representative must submit the verification results as part of a confirmation report by July 1 of each year.

Thus, the first possible verifications would take place in the first six months of 1996 for energy savings that occur in 1995, following submittal of a Reduced Utilization plan by November 1995. The EPA Administrator may grant, however, for good cause shown, an extension of the time to file the confirmation report.

Unlike the Reserve program, a utility using the Reduced Utilization provision does not have to meet the least-cost planning or net income neutrality requirements. Since the utility is saving its own allowances, the utility is not limited to the amount of efficiency savings or renewable energy generation for which it may receive credit.

5. Evaluating the Impact of Reduced Utilization

The following work sheet leads the analyst through the steps necessary to assess the value of efficiency and renewable energy from the Reduced Utilization provision. This work sheet provides only an estimate; the actual value is determined retrospectively by the procedures in 40 CFR 72.91 and 72.92. The primary data needs to evaluate the impact of the Reduced Utilization provision are:

- ❑ Average baseline heat input (mmBtu) from 1985-87 for all Phase I units.
- ❑ Heat rates (fuel input/generation output in Btu/kWh) for all Phase I units.
- ❑ System average SO_2 emission rate of all Phase II units.
- ❑ Average SO_2 emission rate of all off-system purchases.
- ❑ MWh savings from qualified energy efficiency or MWh generation from renewable energy sources in each year of Phase I. Measures must have been installed on or after January 1, 1988.
- ❑ Market price of allowances.

Work Sheet No. 3
Evaluating the Impact of Reduced Utilization

Potential Number of Allowances Surrendered

STEP 1:

Determine if the utility system's aggregated Phase I units are expected to operate below their 1985-87 baseline, and, if so, how far below (mmBtu).[12] If the Phase I units are not expected to operate below baseline, Reduced Utilization does not apply. If the Phase I units are expected to operate below baseline in any year, continue to step 2.

	mmBtu

STEP 2:

Determine the utility's average emission rate for electricity not generated at Phase I units (lbs of SO_2/mmBtu). For the portion of non-Phase I generation from within the utility's system, determine the average emission rate for the system's Phase II units. For the portion of non-Phase I generation from outside of the utility's system, find the average emission rate for the utility's NERC region (listed in 40 CFR Part 72.92). Calculate the weighted-average emission rate from these two values.

	lbs/mmBtu

STEP 3:

Determine the potential number of allowances to be surrendered due to reduced utilization by multiplying the result from step 1 by the result from step 2. Divide result by 2000 to convert pounds of SO_2 to tons. The tons of SO_2 represent the number of allowances the utility would surrender without energy efficiency and/or sulfur-free generation.

	Allowances

Potential Number of Allowances Saved by Energy Efficiency and Sulfur-Free Generation

STEP 4:

Determine the total amount of system-wide savings (kWh) from energy efficiency and the total system-wide generation (kWh) from sulfur-free sources. Add these two values together. *Note that the energy efficiency measure(s) must have become operational after December 31, 1987 to qualify, and must be verified.*

	kWh

(continued on next page)

Work Sheet No. 3 (cont'd)
Evaluating the Impact of Reduced Utilization

STEP 5:

Determine the weighted-average heat rate (Btu/kWh) for the Phase I unit(s) that have been operated below the 1985-87 baseline.[13] The weighting is based upon the percentage each unit is below the baseline.

Btu/kWh

STEP 6:

Convert the total kWhs in step 4 to an equivalent heat value (Btu) by multiplying the result from step 4 by the result from step 5. Divide the result by 10^6 to convert Btu to mmBtu.

mmBtu

STEP 7:

Determine the potential number of allowances saved by energy efficiency and sulfur-free generation by multiplying the result from step 6 by the result from step 2. Divide result by 2000 to convert pounds of SO_2 to tons. The tons of SO_2 represent the potential number of allowances saved.

Allowances

Value Added by Energy Efficiency and Sulfur-Free Generation

STEP 8:

Apply the allowances saved in step 7 toward offsetting the allowances surrendered in step 3. Apply these allowances until all the surrendered allowances in step 3 are offset or the available allowances in step 7 are used up.

Allowances

STEP 9:

Multiply the number of allowances offset in step 8 by the market value for emission allowances. This result is the value added by energy efficiency and sulfur-free generation from the Reduced Utilization provision. Repeat steps 1 - 9 for each year 1995 through 1999.

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Basics of the Clean Air Act Incentives for Energy Efficiency and Renewable Energy

		Avoided Emissions	Reserve Allowances	Reduced Utilization
Who May Apply?		Anyone Can Benefit; No Application	Owner/Operator of Any Affected Utility or IPP	Owner/Operator of Phase I Affected Units
Utilities Must Have a Least-Cost Plan and Net Income Neutrality?		No	Yes	No
What Type of Measures?		Demand-and Supply-Side Efficiency; Renewable Energy	Demand-Side Efficiency; Renewable Energy	Demand-and Supply-Side Efficiency; Renewable Energy
At What Rate are Allowances Earned/Saved?		Utility's Own Rate of Emissions	500 MWh = 1 Allowance	Average emission rate of the system's Phase II units
How Many Allowances Are Available?		No limit	300,000 Total	No Limit
When Are Utilities Eligible?				
	Phase I	From 1995 on	From 1992 until 1995	From 1992 until 2000
	Phase II	From 2000 on	From 1992 until 2000	Not eligible

Timeline for the Incentives

January 1, 1992

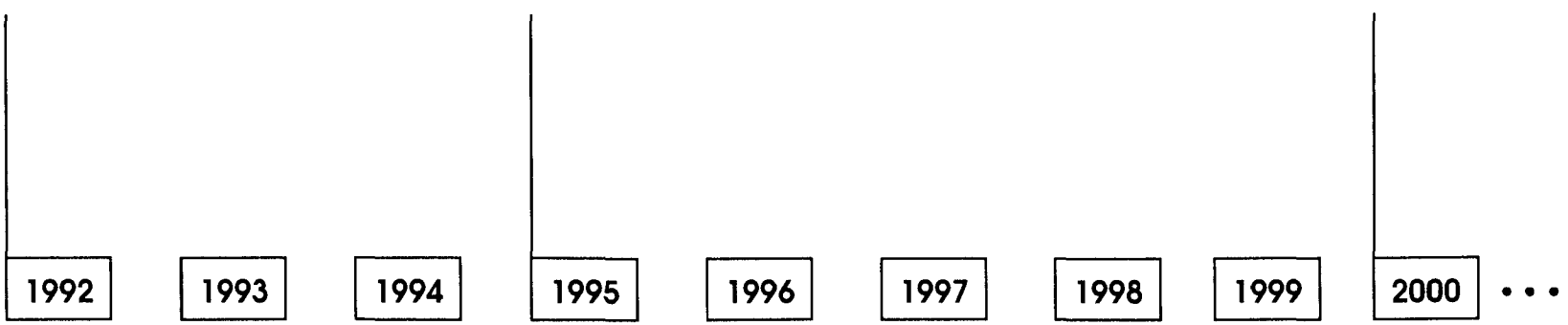
- Conservation and Renewable Energy Reserve begins

January 1, 1995 (Phase I Begins)

- Avoided emissions incentive begins for Phase I utilities
- Reserve no longer available to Phase I utilities
- Reduced utilization provision begins

January 1, 2000 (Phase II Begins)

- Avoided emissions available to all affected utilities
- Reserve no longer available to Phase II utilities
- Reduced utilization provision ends



Part III

Efficiency and Renewable Energy in SO_2 Compliance Strategies

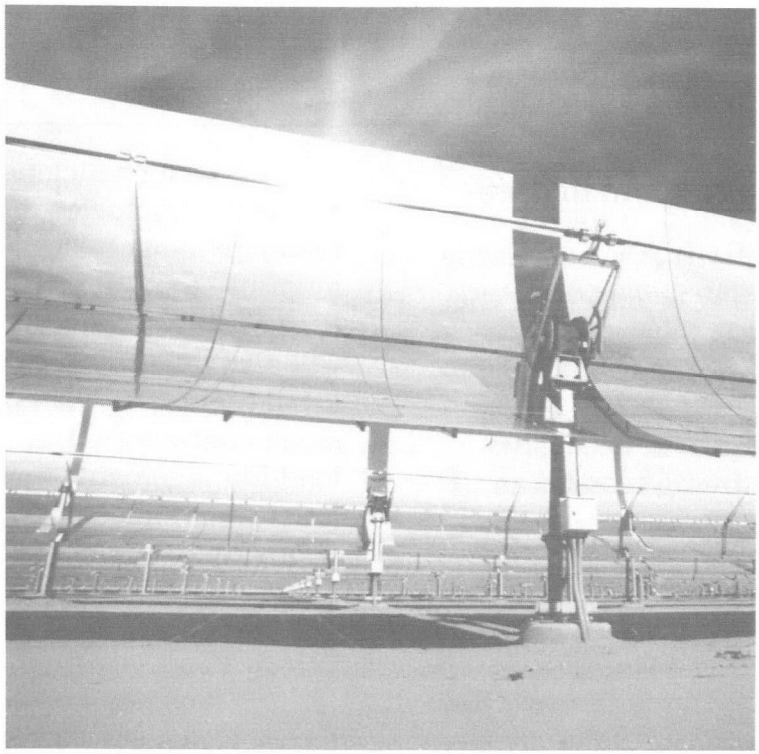


Photo courtesy of Kramer Junction Company

To meet SO_2 emission requirements of Title IV, electric utilities may choose from a range of compliance options. Efficiency and renewable energy can be a cost-effective component to an integrated compliance strategy.

This part discusses the how the three incentives affect SO_2 compliance strategies.

A. SO_2 Emissions and Resource Type
B. Avoided Emissions
C. Conservation and Renewable Energy Reserve
D. Reduced Utilization

The market-based nature of Title IV of the Clean Air Act gives utilities a range of options for meeting compliance needs. Efficiency and renewable energy can play a significant role in this process by:

- Complementing or offsetting the use of other compliance strategies such as fuel-switching,
- Delaying the use of expensive alternative strategies such as scrubbing,
- Helping to avoid penalties associated with noncompliance, and
- Increasing revenues through the sale of extra allowances.

As the examples below illustrate, the potential usefulness of the three Clean Air Act incentives varies depending on each utility's own unique circumstances. The existing plant mix, emissions levels, and operating costs all affect the financial impact of the incentives. This chapter discusses and illustrates the application of the three Clean Air Act incentives to encourage the use of efficiency and renewable energy.[14]

A. SO_2 Emissions and Resource Type

Specific efficiency and renewable energy technologies differ in terms of resource availability and the type and amount of pollutants being offset. The level of emissions that can be avoided will also differ by utility. Each existing fossil fuel plant will have different emissions characteristics. In the case of load management programs, the amount of emissions avoided also depends upon the characteristics of the plants to which generation is transferred.

Efficiency and renewable energy technologies generally fall into three load-type categories: base-load, intermediate-load, and load management.

1. Base-Load Generation

Base-load technologies or programs reduce demand during both on- and off-peak periods. Typical demand-side base-load technologies include refrigeration, water heating and exit lights. Supply-side base-load efficiency technologies include amorphous core transformers and base-load power plant efficiency improvement programs. Geothermal resources and biomass-fired steam generation are examples of renewable energy technologies that can operate as base-load units.

The emissions avoided due to base-load technologies are those emissions associated with the generation that is on the margin at any given time throughout the day when the technology is operating. The generation unit on the margin depends on the utility's specific plant mix. During off-peak periods, the emissions that will be avoided due to the efficiency or renewable energy technologies are likely to be those of the base-load plants.

2. Intermediate-Load Generation

In contrast to base-load technologies and programs, intermediate-load technologies and programs reduce demand during on-peak periods only, when energy costs are highest. While base-load programs are meant to reduce demand 24 hours per day, intermediate-load programs generally reduce demand during an 8 to 16 hour period depending on the size and length of system peak.

Commercial lighting programs and air conditioning and heating programs are some examples of typical intermediate-load demand-side programs. Wind and solar energy technologies are examples of intermediate-load renewable resources.

Emission reductions from intermediate-load units are those reductions associated with the plants on the margin during intermediate and peak periods. Peaking plants are high-fuel, low capital cost plants such as oil and gas-fired combined-cycle plants or combustion turbines. Such plants emit considerably less SO_2 than coal-fired plants. Thus, reduced generation at these plants will not lower SO_2 emissions as dramatically as reductions at coal-fired units.

3. Load Management

Load management technologies and programs shift demand from on-peak periods with high energy costs, to off-peak periods with lower costs. Unlike base- and intermediate-load programs, which focus on reducing energy use (MWh), load management programs focus on shifting demand (MW). Load management programs generally save little energy and sometimes actually increase energy use.

Load management programs also can result in *increased* emissions (see "Contrary Effects" box). The increased emissions can occur when generation is shifted from a clean peak period unit (e.g., wind energy resource) to a higher emitting off-peak unit (e.g., a base-load coal-fired unit).

Contrary Effects of Load Management Programs

Certain types of demand-side management programs, load management and off-peak promotional programs, may actually result in *increased* emissions rather than avoided emissions. Load management programs trim peak usage and sometimes transfer that usage to off-peak periods. If the generation source being used at the off-peak time (e.g., a coal unit without a scrubber) emits greater emissions per unit of generation than the peaking unit, this "contrary impact" can occur. Off-peak promotional programs virtually guarantee increased emissions since the purpose of these off-peak programs is to increase the utilization of existing plants in an effort to minimize rates.

Parametric modeling of Utility A, the 6,000 MW mid-and high-sulfur coal-using utility, illustrates these two effects. The load management program actually results in increased emissions that require the surrender of additional allowances. This utility possesses a large allowance reserve margin due to having scrubbed a large Phase I unit and received bonus allowances through the scrubber bonus allowance lottery. Therefore, for Utility A, the load management program represents a loss of potential revenue from the sales of extra allowances. For a utility without an allowance reserve, a load management program would require the purchase of additional allowances or the use of another compliance strategy to counteract the emissions impacts of the program.

The contrary emissions impact of this utility's hypothetical load management program dilutes the impact of the utility's demand-side management programs as a whole. The emissions avoided by the three programs in aggregate (the refrigerator, commercial lighting, and load management program) are reduced as a result of the load management program.

As expected, the off-peak promotion program resulted in increased emissions. By 2010, this program required the surrender of almost 38,000 allowances more than the "no DSM" scenario. For utilities without excess allowances a promotional program could require the purchase of additional allowances or reliance on alternative compliance strategies.

B. Avoided Emissions

Each ton of SO_2 avoided through the use of efficiency and renewable energy means one less allowance must be surrendered to comply with the Clean Air Act. The result is an allowance that can be used for current compliance, banked for future use, or sold. As described in Part I, avoided emissions is the simplest of the three incentives to implement -- no reporting, applications or verification are required.

The effectiveness and simplicity of avoided emissions makes this incentive a potentially major contributor to a utility's Clean Air Act compliance strategy. The actual impact of an avoided emissions strategy depends upon the unique character of the utility system. Avoided emissions save the utility allowances at the utility's own rate of emissions. Thus, utilities that currently emit high levels of SO_2 can benefit significantly from avoided emissions.

Depending upon the utility's Title IV compliance status, these avoided emissions may complement compliance strategies such as fuel switching, or add to the utility revenues through the sale of allowances. All utilities should calculate the avoided emissions benefits of efficiency and renewable energy for each utility's own circumstances.

UTILITY PROFILE
Northern States Power Company

Northern States Power (NSP), headquartered in Minneapolis, Minn., is a national leader in utilizing efficiency and renewable energy resources. As early as 1980, NSP explored the feasibility of harnessing wind to produce electricity. Demand-side management at NSP began with appliance rebates in 1982 and has grown steadily since then.

Wind Energy Commitment

After extensive research and analysis, NSP last year signed a power purchase arrangement with U.S. Windpower Corporation of Oakland, California. Under terms of the arrangement, U.S. Windpower will construct, own and operate the Buffalo Ridge Windplant on a site owned by NSP near Lake Benton in southwestern Minnesota. The Buffalo Ridge site provides ideal weather and geographic conditions for operating a reliable and cost-effective wind plant.

NSP Test Windplant in Holland, Minnesota

The first stage of the wind energy project will be a 25-megawatt power purchase arrangement. This initial commitment is scheduled to be on-line by May 1, 1994. Additionally, NSP has committed to a total of 100 megawatts of wind-derived energy by 1998, and plans to use a competitive bid process to achieve the additional 75 megawatts.

At an output of 25 megawatts, the Buffalo Ridge Windplant will generate enough electricity to power approximately 10,000 to 15,000 homes each year. NSP and its customvers will enjoy the benefits of avoided SO_2 emissions, and NSP could earn bonus allowances from the Conservation and Renewable Energy Reserve. Likewise, NSP estimates that for every kilowatt-hour of fossil fuel generation offset by wind energy, between 1-2 pounds of carbon dioxide will be kept out of the atmosphere.

(continued)

Innovative DSM Programs

NSP has set a goal to reduce 1,000 MW of system coincident demand by 1995 and 1,700 MW by 2000. By the end of 1992, NSP had reduced coincident demand by 643 MW - nearly 60 percent of the 1995 goal. The number of DSM programs has increased dramatically, from 25 in 1989 to more than 60 programs in 1994.

Three programs represent the core of NSP's DSM effort: a commercial and industrial Lighting Efficiency Program, a load control program called Saver's Switch℠, and an interruptible rate program called Peak- and Energy-Controlled Rates. The Lighting Efficiency Program achieved 20 MW of demand reduction in 1992, considerably aided by the Energy Financing Program, which disbursed almost $5 million in low-interest loans for energy-efficient equipment.

One of NSP's long term goals is to increase DSM efforts by improving existing programs and adding new programs aimed at conservation and load management. For example, in 1993 NSP added a preventative maintenance incentive to commercial and industrial programs for chiller, rooftop, and refrigeration efficiency. Cleaning and checking this equipment on a regular basis can improve energy efficiency by 10 to 20 percent.

Also in 1993, NSP became the first US utility to offer a specific rebate program to business customers who convert existing chillers from chlorofluorocarbon (CFC) refrigerant to non-CFC refrigerants. Additionally, NSP is upgrading the lighting in its own facilities through participation in EPA's Green Lights Program.

1. Avoided Emissions and Demand-side Efficiency

Utilities already committed to a compliance strategy based upon scrubbing or fuel switching may be sufficiently placed to meet Title IV requirements. However, avoided emissions through efficiency and renewable energy can still benefit the utility. The extra allowances generated by the avoided emissions can be sold on the allowance market and thus increase utility revenues.

Example: Utility with Excess Allowances

Utility A is a mid-sized (6,000 MW) utility that relies heavily on medium- and high-sulfur coal. The utility's CAAA compliance strategy is to scrub one plant during Phase I and one plant during Phase II. Consequently, this utility projects a large allowance reserve margin during both Phase I and Phase II.

Three typical demand-side efficiency programs are modeled: A refrigerator program representing a base-load program, a commercial lighting program representing an intermediate-load program, and a peak-load program representing load management. Together the programs are expected to reduce Utility A's peak load by five percent, an impact typical of moderately aggressive demand-side efficiency programs.

The programs are modelled parametrically to capture interactive effects. The steps to parametric analysis and production-simulation modeling are discussed further in Appendix A. The results of the modeling effort are summarized in Table III-1.

(continued)

The "no DSM" case resulted in the highest emissions level at more than 3.5 million tons of SO_2. Of the three individual programs, the high efficiency refrigerator program achieved the greatest emission reductions. Refrigerator programs reduce generation around the clock and thus lessen the usage of higher emitting coal-fired units. The load management program resulted in more emissions than even the "no DSM" scenario. For an explanation of this effect, see the "Contrary Effects" box.

Given the utility's strategy to scrub during Phase I, implementation of the three demand-side programs will create additional allowances that the utility may bank or sell. The demand-side programs will increase allowance holdings by almost 143,000 by 2010. The allowances saved by the demand-side programs may allow the utility to consider less expensive compliance options for Phase II. These options might include supply- or demand-side efficiency programs, renewable energy, and/or fuel switching.

If utility A continues with plans to scrub a unit during Phase II, the utility would not need the allowances saved by the demand-side programs for compliance purposes. However, the allowances would still have value in terms of added revenue. For example, if the utility sold the nearly 143,000 additional allowances "created" by DSM at $200 each, it would generate nearly $29,000,000 in added revenue.

Table III-1
Emissions Impacts of DSM Programs

	Cumulative SO_2 Emissions (tons)	Emissions Savings	Allowance Balance (Allowances)
"No DSM" Scenario	3,546,100	0%	1,990,700
System with Refrigerator Program	3,435,700	3%	2,101,100
System with Commercial Lighting Program	3,480,400	2%	2,056,500
System with Load Management Program	3,573,900	-1%	1,963,000
System with Refrigerator, Lighting, and Load Management Programs	3,403,200	4%	2,133,700

The following example illustrates how demand-side management programs can allow a utility to defer the use of other Clean Air Act compliance strategies.

Example: Deferring Compliance Strategies

Utility C, a large (28,000 MW) utility for which medium-sulfur coal is the primary fuel, has 28 Phase I affected units, and approximately 80 Phase II-affected units. The company's Phase I compliance strategy is to switch fuels at Phase I-affected units. This strategy will reduce emissions considerably below the number of allocated allowances.

In Phase II, however, the utility's annual SO_2 emissions will be greater than the annual allowance allocation. During Phase II the utility plans to use allowances banked during Phase I to remain in compliance. Once the allowance reserve margin is depleted, the company intends to purchase allowances to remain in compliance.

Two scenarios are modeled to illustrate the effects of DSM on Utility C's compliance costs. The first scenario contains no DSM, and the second scenario assumes that the utility implements aggressive demand-side programs.

(continued)

The DSM programs include residential, commercial, and industrial programs for new and existing facilities. These programs cover a wide range of technologies, including building envelope, heating, ventilating, air conditioning equipment, lighting, motors, water heating, and load control programs. In 1993 about 80 MW of DSM will be in place. DSM programs are ramped up quickly, reaching a maximum of nearly 4,000 MW in the year 2001. From 2001 to 2010, the last year modeled, the nearly 4,000 MW of DSM represents approximately 14 percent of the utility's total system capacity.

The DSM programs affect the utility's emissions by varying degrees over time. For example, in 1999, the final year of Phase I, the demand-side efficiency programs earn approximately 20,000 allowances more than the amount the utility would have earned without DSM. During Phase II, that amount increases to over 50,000 allowances in the year 2001. Cumulatively, by 2007, this utility would save over 300,000 allowances through the DSM programs. In the absence of the demand-side programs, the utility would need to purchase nearly 165,000 additional allowances or change its compliance strategy. Conversely, with the DSM programs the utility would possess over 130,000 extra allowances. Thus, DSM could defer for almost two years the need for this utility to purchase additional allowances or otherwise alter compliance strategies.

2. Avoided Emissions and Supply-Side Efficiency

Like demand-side efficiency programs, supply-side efficiency programs can also avoid SO_2 emissions. And like demand-side efficiency programs, the amount of avoided emissions will depend upon the characteristics of the specific program and the emission characteristics of the plant that is being avoided.

To calculate the avoided emissions from a supply-side efficiency program, the system with and without the efficiency program are modeled using a production-simulation model. In some instances, such as boiler efficiency improvements, the analyst may only need to adjust the plant heat rates assumed in the model.

Example: Amorphous Core Transformers

Amorphous core transformers improve efficiency by decreasing core losses. Amorphous metal cores can reduce core losses by 60-70 percent compared to conventional silicon steel core transformers. Since core losses constitute approximately 50 percent of the total losses from transformers, replacement of conventional transformers with amorphous core transformers can reduce total transformer losses by approximately one-third. Amorphous core transformers increase efficiency during all time periods and are thus considered a base-load efficiency option.

Assume that Utility B institutes a program to replace conventional transformers with amorphous core transformers across its system. Total transmission

(continued)

and distribution losses are approximately seven percent; transformer losses account for approximately 25 percent of the total transmission and distribution losses. The total savings potential, assuming replacement of all transformers, is approximately 0.6 percent of system generation.

If Utility B adopts a transformer replacement program, with a target of replacing one-fourth of all transformers by the year 2000, the utility would realize approximately 60 GWh per year in energy savings. These energy savings avoid approximately 165 tons of SO_2 per year.

Such supply-side efficiency improvements can play an important role in a utility's overall energy efficiency strategy and will yield benefits relative to Clean Air Act compliance. The utility also benefits from the reduced energy, transmission and distribution costs.

3. Avoided Emissions and Renewable Energy

Like energy efficiency technologies, renewable energy resources vary in the emissions avoided depending upon the characteristics of both the technology and the utility system. Some renewable energy resources, such as geothermal and biomass generation, can be dispatched in the same manner as traditional generation technologies. These resources are likely to be operated as base-load or intermediate-load units.

Although solar and wind energy technologies are by nature intermittent, the availability of these resources can often be predicted with a high degree of certainty. Moreover, technologies are under development to cost-effectively store the energy generated from inter-

mittent resources. Solar and wind energy technologies are now generally considered to be intermediate-load units.

Generating electricity from sulfur-free renewable energy technologies can displace equivalent generation from sulfur-emitting sources, thus avoiding SO_2 emissions. Emissions are avoided at the emission rate of the sulfur-emitting unit, which can be significantly higher than the rate allowances are earned under the Reserve. Consequently, utilities that have implemented or are planning to implement renewable energy projects should incorporate avoided emission benefits into compliance planning.

Utilities with high-sulfur units capable of being displaced by renewable energy generation stand to gain the most from renewable energy technologies. However, as the following example shows, even utilities with low-sulfur units can find that additional renewable energy generation may lead to the least-cost compliance strategy.

Example:
Wind Energy and Avoided Emissions

Utility B, a 7,000 MW utility, provides an example of the potential effect of wind energy on avoided emissions. Wind energy can be thought of as an intermediate-load technology with a typical capacity factor of approximately 0.3, depending on the specific technology used, site characteristics and wind profile.

(continued)

Utility B plans to add wind energy capacity in several years throughout Phases I and II. Specifically, the utility plans to add 25 MW of wind energy in 1995, 25 more MW in 1997 and a final 50 MW in 2000, for a total of 100 MW installed capacity by 2000.

Utility B has one affected Phase I unit and 20 affected Phase II units. Well in advance of passage of the Clean Air Act Amendments, Utility B implemented a SO_2-reduction strategy that included fuel-switching and scrubbing. Consequently, all Utility B units already have emission rates that meet Phase II requirements. By reducing SO_2 prior to implementation of Phases I and II of the Clean Air Act, this utility will possess a large allowance reserve margin.

The implementation of these levels of wind energy would result in the utility's saving over 3,300 allowances, i.e., avoiding over 3,300 tons of SO_2 emissions compared to a "no wind energy" scenario by the year 2010. The avoided emissions due to wind power generation are not concentrated in any single unit or units, but are distributed relatively evenly among Utility B's Phase II units, which are all low-sulfur units. The 3,300 allowances saved due to Utility B's wind energy plans would be three percent of the cumulative allowance balance for the "no wind energy" scenario. If retained by Utility B, these allowances would add to the existing allowance reserve margin. If the additional allowances due to the implementation of wind energy were sold at $200 per allowance, the value of the avoided emissions would be about $660,000 (or $1.2 million at $350 per allowance).

Again, these results are for a relatively "clean" utility. If the utility had a higher SO_2 emission rate, the benefits would be even greater.

C. Conservation and Renewable Energy Reserve

The bonus allowances from the Conservation and Renewable Energy Reserve increase the attractiveness of demand-side efficiency and renewable energy resources as SO_2 compliance strategies. Since the Reserve allowances are earned before a utility actually enters the Acid Rain Program, the Reserve is an early way to earn a return on efficiency and renewable energy investments. Once the utility enters the Acid Rain Program, the measures or generation installed continue to benefit through avoided emissions and/or the Reduced Utilization provision. Thus, each of the Title IV incentives are complementary in supporting efficiency and renewable energy as SO_2 compliance strategies.

1. Reserve Allowances and Earning Potential

The number of allowances a utility will earn from the Reserve depends upon two factors: (1) the size of the utility's efficiency and/or renewable energy program, and (2) the number of years the utility is eligible. Phase I utilities may earn Reserve allowances for demand-side measures or renewable generation during a three year period from January 1, 1992 until January 1, 1995. Phase II utilities may earn Reserve allowances during an eight year period from January 1, 1992 until January 1, 2000.

A Phase II-affected utility that began full-scale, aggressive conservation and/or renewable energy programs in 1992 possesses the greatest opportunity to benefit from the Reserve. However, the bonus allowances from the Reserve can affect the role of efficiency and renewable energy for all utilities and independent power producers affected by Title IV of the Clean Air Act. In many instances the role of the Reserve allowances will be to allow the sale or banking of excess allowances.

Example: Reserve Allowances for a Phase I Utility

Utility B, a 7,000 MW utility, has one affected unit in Phase I, and is therefore only eligible to gain Reserve allowances from 1992 until 1995. Despite being eligible for Reserve allowances for only a three-year period, Utility B has in place a relatively aggressive package of DSM programs as part of its base plan. Assuming that Utility B achieves and verifies the projected energy savings, and meets net income neutrality and least-cost planning requirements, the utility will gain a significant number of Reserve allowances.

Table III-2 summarizes Utility B's potential for gaining Reserve allowances through DSM. Note that the DSM savings from one year continues to add to the total of a following year, provided the measure is still in place. Based upon Utility B's projected programs, the utility will earn a total of 2,150 allowances from the Reserve. Since Utility B is already in compliance with both Phase I and Phase II requirements, the utility does not need the Reserve allowances for Title IV compliance. At a market value of $250 per allowance, Utility B would earn $537,500 from the sale of the 2,150 bonus allowances ($725,500 if market price is $350 per allowance).

Table III-2
Reserve Allowances of Utility B

Year	Savings (GWh)	Allowances
1992	159	318
1993	349	698
1994	567	1,134
Total	1,075	2,150

Example:
Reserve Allowances for a Utility With only Phase II Units

Utility D has no units affected in Phase I and is therefore eligible to gain Reserve allowances from 1992 until 2000. Utility D is allocated approximately 100,000 allowances annually in Phase II, and plans to use less than this number to comply. Therefore, any allowances gained through the Reserve can be either sold or banked.

Utility D has modest plans for DSM and expects to achieve its first savings from energy efficiency programs in 1994. As Table III-3 illustrates, Utility D's projected programs will earn the utility 10,970 allowances through the Reserve. This result assumes that the programs are implemented as planned, savings are verified and accepted as valid by EPA, and the utility meets net income neutrality and least-cost planning requirements. At a market value of $250 per allowance, Utility D would earn $2,742,500 from the sale of the 10,970 bonus allowances ($3,839,500 if market price is $350 per allowance).

2. Reserve Allowances and Compliance Flexibility

The examples illustrate the benefits of Reserve allowances for utilities that will have allowances in excess of SO_2 emissions from affected units in Phase I and Phase II. The excess allowances generated in the examples can be sold or banked for future use. The excess allowances give both Utility B and Utility D an added reserve margin for ensuring compliance with Title IV.

Reserve allowances can also increase compliance flexibility and timing. While the benefits from the Reserve alone are not likely to completely alter SO_2 compliance strategies, the Reserve allowances can help delay more costly strategies such as scrubbing.

Table III-3
Reserve Allowances of Utility D

Year	Savings (GWh)	Allowances
1992	0	0
1993	0	0
1994	114	228
1995	391	782
1996	778	1,556
1997	1,132	2,264
1998	1,413	2,826
1999	1,657	3,314
Total	5,485	10,970

D. Reduced Utilization

The Reduced Utilization provision allows utilities to reduce operation of affected units during Phase I as a means of compliance. However, to prevent utilities from circumventing Phase I requirements by shifting generation from affected units to non-affected units, utilities that reduce utilization below their 1985-87 baselines must identify a compensating unit or surrender allowances unless one of the following compensating actions are taken:

1. Shift to a sulfur-free generator;
2. Offset with demand-side efficiency measures; or
3. Offset with supply-side efficiency measures.

The Reduced Utilization provision is only invoked if a unit's generation drops below its 1985-87 baseline and is only applicable to electric utilities with units affected by Title IV during Phase I.

1. Reduced Utilization and Phase I Compliance

Reduced Utilization achieved through demand-side efficiency, supply-side efficiency, or sulfur-free renewable energy is a potential strategy for meeting Phase I compliance requirements. The avoidance of costs associated with efficiency and renewable energy should be considered in the evaluation of the cost-effectiveness of these resources.

Example: Reduced Utilization in Phase I Compliance

Utility B's only Phase I-affected unit is currently in compliance with Clean Air Act requirements due to early switching to low-sulfur fuel. Alternatively, Utility B could have used the Reduced Utilization provisions to comply with Phase I requirements.

If Utility B simply shifted the generation of the utility's Phase I unit to other units (most of which would be Phase II units), the utility would have to identify a compensating unit or surrender allowances. The allowances are surrendered at the average emission rate of the system's Phase II units. However, since Utility B can attribute the reduced utilization to compensating amounts of DSM, the utility would avoid bringing a Phase II unit into Phase I or surrendering these allowances.

Utility B is planning to implement enough demand-side efficiency to offset the entire generation of the affected Phase I unit. Whereas the baseline generation of Utility B's Phase I unit is about 300 GWH, the projected savings from the utility's demand-side efficiency programs range from 1,250 GWH in 1995 to 2,500 GWH in 1999 for measures operational since January 1, 1988. Thus, the projected energy savings are greater than baseline generation, and Utility B could theoretically reduce the generation of the Phase I unit to zero without surrendering allowances.

In this case, the value of the compensating DSM is equal to the baseline heat input of the Phase I unit times the average SO_2 emission rate of Utility B's Phase II units. This amount equals 915 tons of SO_2 for each year, 1995-1999. Utility B thus avoids surrendering 915 allowances each year from 1995 through 1999, the eligibility period for Reduced Utilization. In total, 4,575 allowances are saved

(continued)

during this period. At a market price of $250 per allowance, the utility has saved $1.14 million (at $350 per allowance, the utility saves $1.60 million).

In this case, Reduced Utilization provides the means for meeting Utility B's Phase I requirements. The utility is planning to implement enough efficiency and renewable energy programs to offset the production of the Phase I unit even without consideration of Clean Air Act requirements.

2. Relevant Circumstances for Reduced Utilization

Reduced utilization is an attractive strategy for utilities with units affected in Phase I that have relatively large demand-side efficiency, supply-side efficiency, and/or renewable energy programs either in place or planned. Since the savings or generation attributable to measures installed anytime after January 1988 are eligible, utilities with mature, long-running programs are likely to save the most allowances.

Reduced Utilization is most applicable to older, less-efficient units with relatively high operating costs. Reducing utilization of a newer, efficient baseload unit with lower production costs is less likely. The allowance benefits may not be enough to offset these low production costs.

The use of Reduced Utilization also depends upon whether the utility offsets enough Phase I generation to cause the Phase I unit to drop below baseline. If the efficiency and renewable energy programs do not cause the unit's generation to drop below the 1985-87 baseline, then Reduced Utilization does not apply. However, emissions would still be avoided and allowances saved, but "avoided emissions" would be the applicable incentive.

3. Reduced Utilization and the Reserve: Complementary

A strategy incorporating both Reduced Utilization and the Reserve can be particularly beneficial. The same demand-side efficiency and renewable energy measures that earned bonus allowances from the Reserve up until 1995 may save allowances for a Phase I utility under the Reduced Utilization provisions from 1995 through 1999. In fact, Reduced Utilization may yield even greater benefits than the Reserve:

- Eligibility requirements for Reduced Utilization are less strict than for the Reserve. Unlike the Reserve, a utility using the Reduced Utilization provision does not have to meet the least-cost planning or net income neutrality requirements.
- Unlike the Reserve, which has a limited pool of bonus allowances to be awarded, Reduced Utilization has no limit as to how many allowances may be saved.
- While the Reserve awards bonus allowances only for demand-side efficiency and renewable energy programs, the Reduced Utilization opportunity exists for supply-side efficiency programs as well.
- The Reserve allowances are based on a set formula of 1 allowance for every 500 MWh of energy savings or renewable energy generation. No set formula exists for Reduced Utilization. Reduced Utilization generates allowances based upon the average emission rate of the system's Phase II units.[15]
- To qualify for the Reserve, efficiency and renewable energy projects must have been installed on or after January 1, 1992. Measures installed on or after January 1, 1988 qualify for Reduced Utilization.

Example: Reserve and Reduced Utilization Allowances

Allowances earned through the Reserve were compared with allowances saved via Reduced Utilization for Utility B. The utility is able to earn 2,150 allowances from the Reserve, based on the formula of one allowance for every 500 MWh. The utility saves 915 allowances per year from the Reduced Utilization provision. This annual savings of 915 allowances is based upon 300,000 MWh of efficiency savings (one allowance for every 327 MWh).

The saved allowances for Utility B due to Reduced Utilization are based on a system average SO_2 emission rate for all Phase II units. Utility B's average Phase II emission rate of 0.55 lb/mmBtu reflects a reliance on low-sulfur coal.

Utilities with higher Phase II emission rates would save a greater number of allowances per kilowatt-hour saved. For example, if the average emission rate of Utility B's Phase II units was 2.5 lbs/mmBtu, Utility B would save 4,138 allowances. In this case, one allowance is saved for every 71 MWh of efficiency savings or renewable energy generation.

Part IV

Efficiency and Renewable Energy Cost-Effectiveness

Photo courtesy of Osram Sylvania Inc.

Avoided SO_2 emission costs alter the economics of conventional utility generation. The cost-effectiveness of efficiency and renewable energy in program design and screening, bidding, and system dispatch are all improved by the Title IV incentives.

This part discusses the impact of the Title IV incentives on calculating avoided costs and the implications of an increased avoided cost on utility planning, bidding, and dispatch.

A. Avoided Costs
B. Demand-side Management Programs
C. Supply-side Efficiency Programs
D. Renewable Energy Projects
E. Bidding
F. System Dispatch

The Clean Air Act will increase the attractiveness of resources that do not emit SO_2. The economic value of these alternate energy resources is measured primarily by the costs of conventional supplies that are avoided. The previous section described how the Clean Air Act incentives affect SO_2 compliance strategies. This section examines how the Clean Air Act affects utility planning and the overall cost-effectiveness of efficiency and renewable energy projects.

Avoided cost values are critical to the resource selection process. The utility first develops a base-load forecast to determine the long-term need for additional energy resources. The utility then develops a base supply plan, to meet the electricity requirements of the base forecast. Such base supply plans most often employ traditional supply resources. The costs avoided by not implementing the base supply plan is compared to the cost of other resource options such as efficiency and renewable energy. Resources costing less than the avoided cost of the base supply resources should be implemented.

Part IV shows how the costs of avoided SO_2 emissions will alter overall avoided cost. The added SO_2 costs incurred by traditional resources will improve the cost-effectiveness of efficiency and renewable energy options.

A. Avoided Costs

Efficiency and renewable energy resources reduce the need for new fossil-fuel facilities, the amount new and existing plants operate, and the amount of pollutants emitted. For these reasons, efficiency and renewable energy resources may avoid many of the costs associated with a base supply plan. Efficiency and renewable energy are the preferable resource options if the costs avoided by these resources are greater than the costs of their implementation.

Because emission allowances place an economic value on SO_2 emissions, *a utility's avoided costs will change as a result of Clean Air Act compliance strategies.* In turn, increases in avoided costs can increase the amount of efficiency and renewable energy resources that are cost-effective.

1. Calculating Avoided Costs

Avoided costs are derived from a comparison of the cost of building and operating a utility system with and without alternate energy resources. Avoided costs can be broken into components of energy and capacity. The avoided cost of SO_2 emission allowances is a cost which should be incorporated into current avoided cost of energy calculations.

Methods of calculating avoided costs vary. A detailed discussion of avoided cost methodologies is beyond the scope of this Handbook. The following discussion and examples will focus upon the avoided costs of SO_2 emissions.

The avoided cost of SO_2 emissions can be calculated by multiplying the annual difference in SO_2 emissions by the market value of an emission allowance. A more complete calculation is actually more complicated. The analyst must also account for inflationary effects as well as determine the net present value of the cost stream.

2. Avoided Cost and Resource Characteristics

Avoided energy, capacity and SO_2 costs vary for different efficiency and renewable energy options. For programs offsetting base-load generation, the avoided cost per kWh may be less than for intermediate-load options. Although the base-load energy efficiency resource saves more energy, some of that energy is saved during off-peak periods when production costs are lower.

Load management may reduce system energy and capacity costs, but increase system SO_2 emission costs. Likewise off-peak promotion programs often result in increased energy and SO_2 emission costs (See "Contrary Effects" box in Part III).

3. Avoided Costs and Utility Characteristics

The avoided costs associated with efficiency and renewable energy resources vary depending upon utility circumstances. In reality, utilities will implement bundled programs, combinations of multiple base-load, intermediate-load and load management options. Such program combinations which help to maximize the cost-effectiveness of efficiency and renewable energy programs alter the aggregate avoided cost value.

A utility's avoided costs of energy also vary due to generating plant characteristics such as fuel type. A utility using peaking units with costly fuels at the margin will have higher avoided energy costs than a utility using more coal plants. Relying less on coal plants also reduces SO_2 emissions at the margin. Avoided costs must be calculated for each utility's own specific circumstances.

The avoided cost of SO_2 emissions, as represented in the above example, is not the primary contributor to total avoided costs. Although efficiency and renewable energy resources can help to reduce emissions and aid compliance with the Clean Air Act, the primary effect of efficiency and renewable energy resources on avoided costs appears to be avoiding the construction

Table IV-1
Avoided Costs for Utility A

	Base Load, Refrigerator Program (cents/kWh)	Intermediate Load, Commercial Lighting (cents/kWh)	Load Management[a] ($/kW)	Aggregate DSM (cents/kWh)	Wind Energy Project (cents/kWh)	Off Peak Promotion[b] (cents/kWh)
Avoided Cost of Energy	3.62	3.78	40.2	4.08	3.68	3.88
Avoided Cost of Capacity	.56	.93	46.2	1.05	.99	NA
Avoided SO_2 Emission Cost	.15	.15	-1.5	.14	.15	.16
Total Avoided Costs	4.33	4.85	84.9	5.28	4.81	4.05

a The avoided costs for load management are expressed in dollars per kW of load shifted. Because load management, as modeled, does not save energy, the cost value cannot be expressed as a cost per energy avoided.

b The off-peak promotion numbers are not avoided costs, rather they are incremental costs (an increase in the cost per kWh for each additional kWh).

Example: Effect of Efficiency and Renewable Energy on Avoided Costs

The avoided costs of energy, capacity and SO_2 emissions were calculated for five hypothetical load shapes for Utility A. This parametric analysis illustrates the avoided costs associated with a base-load energy efficiency resource, an intermediate-load energy efficiency resource, a peak-load control program, a renewable energy option, and an off-peak promotion program. The first three options are also combined into an aggregate demand-side management program.

Table IV-1 shows the avoided costs of energy, capacity and SO_2 emissions corresponding to the parametric analysis.The results in Table IV-1 are based on a conservative emission allowance value of $200 per allowance. The impact of avoided SO_2 emission costs will be greater at a higher emission allowance price.

As expected, the avoided cost of the base-load refrigerator program is less than the

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avoided cost of the intermediate load commercial lighting program. Part of the savings from the base-load program occurs during off-peak periods when production costs are lower. The load management program actually increased SO_2 emission costs due to increased generation during off-peak periods.

The results for the base- and intermediate-load range energy efficiency resources would also represent the results for renewable energy resources with similar effects on utility load shape. For example, a paper company installing a wood-waste boiler and cogenerator may reduce the company's electricity purchases from the utility around the clock. Thus, the wood-waste project would have the same effect on avoided costs as installing a base-load efficiency resource.

Similarly, an independent power producer may install a photovoltaic system to sell energy to the utility during on-peak periods. The photovoltaic system would reduce existing loads much as would installing an intermediate-load efficiency resource.

Table IV-2
Avoided Costs for Utilities A, B, and C

	Utility A, Demand-Side Resources (cents/kWh)	Utility B, Demand-Side Resources (cents/kWh)	Utility B, Wind Energy Resource (cents/kWh)	Utility C, Demand-Side Resources (cents/kWh)
Avoided Cost of Energy	4.08	5.00	3.02	2.39
Avoided Cost of Capacity	1.05	2.25	2.27	1.60
Avoided SO_2 Emission Cost	.14	.04	.04	.06
Total Avoided Cost	5.28	7.29	5.32	4.05

Example: Avoided Costs at Different Utilities

The avoided costs for three different utilities are given in Table IV-2. This table illustrates how avoided costs can vary with utility circumstances.

The Utility A values represent the avoided costs from the three hypothetical programs, a base-load refrigerator program, an intermediate-load commercial lighting program, and a load management program. Avoided costs for Utility B are given for both the utility's planned demand-side efficiency and wind energy programs. The Utility C values represent the avoided cost from the utility's planned demand-side efficiency programs.

The avoided costs of energy vary with the utility because the types and fuels of generating plants are different. Utility B uses peaking units with costly fuels at the margin whereas Utility C uses more coal plants. This greater use of coal plants means higher SO_2 emissions at the margin, which also explains why the avoided SO_2 emission costs are higher for Utility C.

and operation of costly generating capacity.

Nonetheless, SO_2 emissions pose real costs to utilities, and real benefits accrue from avoiding SO_2 emissions. These costs and benefits must be considered when selecting among energy resource options. *The avoided cost of SO_2 emissions must be included in the total avoided costs when screening, analyzing and implementing resource options.*

The following sections, using selected examples typical of utility resource planning and implementation, illustrates how avoided SO_2 emissions costs can affect energy resource plans.

B. Demand-Side Efficiency Programs

1. Overview

Avoided SO_2 emission costs can affect demand-side efficiency programs by increasing:

- The number of energy efficiency measures that are cost-effective and should be implemented,
- The number of customers participating, and
- The overall energy saved.

Thus, avoided SO_2 emission costs should be an integral part of demand-side resource program design and screening. Demand-side management programs are typically developed and implemented in the following stages:

1. Potential energy efficiency measures are identified and the savings potentials are estimated.
2. The potential energy efficiency measures are screened to determine cost-effectiveness using avoided cost values.
3. Measures that pass the economic screening are bundled into programs for implementation. Avoided costs are used to help set the customer incentive levels.
4. The bundled programs are screened to ensure cost-effectiveness is maintained when program administrative costs and interactive effects between measures are considered. The use of avoided costs in screening the bundled programs is similar in concept and method to screening individual efficiency measures.
5. Programs are implemented, monitored and refined as necessary.

Example: Cost-Effectiveness of DSM Measures

Consider a hypothetical situation of a utility evaluating three different energy efficiency measures. The benefit-cost ratio is calculated both with and without the avoided SO_2 emission costs being considered. In this example, the benefits of the DSM measures stem from the avoided emissions incentive. If the utility also took advantage of the Reserve and/or Reduced Utilization provision, the impact on the avoided costs would be even greater.

Table IV-3 illustrates the impact of avoided SO_2 emission costs on different DSM measures. Measure no. 1 was already cost-effective before the inclusion of the avoided emission costs and became more cost-effective with these costs. Measure no. 2 was just below the cost-effectiveness threshold without SO_2 emission costs, and then becomes cost-effective with the SO_2 emission costs.

Measure no. 3 was not cost-effective before or after the inclusion of the avoided SO_2 emission cost. Thus, the impact of the avoided SO_2 emission costs depends upon both the nature of the DSM measure and the utility.

The economic screen in stage 2 compares the cost of each measure to the avoided cost of the supply resource being offset. An energy efficiency measure is cost-effective when the savings (avoided costs times energy saved) is greater than the measure's cost.

2. Impact on DSM Program Screening

Avoided costs affect the scope of energy efficiency measures being considered. An increase in avoided costs would have the effect of increasing the

Table IV-3
Effect of Avoided SO_2 Emissions Costs on DSM Cost-Effectiveness

	Measure No.		
	No. 1	No. 2	No. 3
Present Value of Avoided Energy ($)	65.00	8.50	129.00
Present Value of Avoided Capacity ($)	10.00	1.50	32.00
Benefit-Cost Ratio w/o SO_2 Costs	1.25	.99	.67
Present Value of Avoided SO_2 ($)	2.50	.50	5.00
Benefit Cost Ratio with SO_2 Costs	1.30	1.02	.69

number of measures that are considered cost-effective and suitable for inclusion in one or more demand-side programs. In some instances, adding the avoided cost of SO_2 emissions will result in additional measures being cost-effective. *The effect of the avoided SO_2 emission cost is very specific to each utility.*

3. Impact on Customer Participation and Savings

Measures that pass the economic screening are bundled into programs designed to implement those measures. Avoided costs are used in the design of the programs to help set the customer incentive levels needed to achieve sufficient customer participation. The customer incentives and program administrative costs will decrease some of the savings in avoided costs.

The customer incentives need to be high enough to achieve savings, but when combined with program administrative costs, less than the avoided cost. *The added avoided SO_2 emission cost may justify a higher customer incentive, and thus can increase customer participation.*

The mechanism for program delivery can affect the impact of the avoided SO_2 emission costs on customer incentives. Delivery mechanism options include rebates, shared savings, and the use of energy service companies.

If the mechanism is utility-administered rebates, small additions to the avoided cost may not greatly affect the levels of customer incentives. Program designers may choose a value significantly below the full avoided cost based on experience or judgement. Program designers also tend to pick round numbers (e.g., a $50 rebate rather than a $48.50 or $51.50 rebate) for simplicity and marketing reasons.

If the mechanism is shared savings with the customer, the costs avoided by the DSM programs are shared between the customer using the device and the utility. For example, the customer may receive 50 percent of the avoided cost for allowing the utility to install the DSM measure. Under a shared savings arrangement, even small additions to the avoided cost will be passed on to the customer. Thus, the avoided SO_2 emission costs would be incrementally added to customer incentive levels.

If the mechanism is purchasing the savings from third-party, energy service companies (ESCOs), the utility will contract with the ESCO to improve the efficiency of customer energy use. The customer may or may not receive additional incentives based on avoided SO_2 emission costs. However, the SO_2 avoided emission costs can help extend the scope of the ESCO's efforts to include additional measures and/or participants.

Example: Participation in DSM Programs

The previous example illustrated how the avoided SO_2 emission cost can increase the number of measures passing the cost-effectiveness screen. However, the avoided SO_2 emission cost also can influence the optimum number of program participants. The present value of the avoided SO_2 indicates the additional resources available to increase incentives or other delivery mechanisms.

Figure IV-1 illustrates how the avoided SO_2 emission costs can increase:

1. The number of program participants, and
2. The amount of energy savings.

C. Supply-Side Efficiency Programs

1. Overview

Supply-side efficiency refers to any efficiency improvements made on the utility's side of the meter. Supply-side efficiency improvements can include transmission and distribution programs such as amorphous core transformer improvements, in-plant programs that improve plant heat rate, and utility in-house efficiency programs such as lighting, heating, and cooling.

Amorphous core transformers reduce standby energy and capacity losses, resulting in more electric power reaching the customer for the same amount of heat input to the power plants. Improving power plant heat rates means that the power plant produces more electricity for a given amount of heat input to the power plant. Utility in-house programs reduce the utility's consumptive use of electricity by using more efficient end-use technologies. In each of these cases, less heat input is required to deliver the same amount of electricity to the customer. Thus, both total heat input and total emissions are reduced as a result of supply-side efficiency improvements.

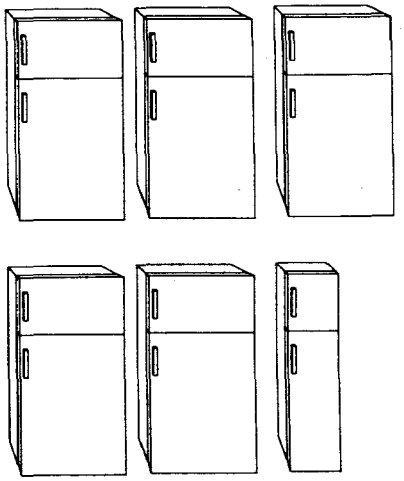
2. Impact of Supply-side Programs on Cost-Effectiveness

Supply-side efficiency measures are considered through a similar process as that for demand-side measures. Avoided costs are used to determine the cost-effectiveness of the various

Figure IV-1
Avoided Costs and Program Participation

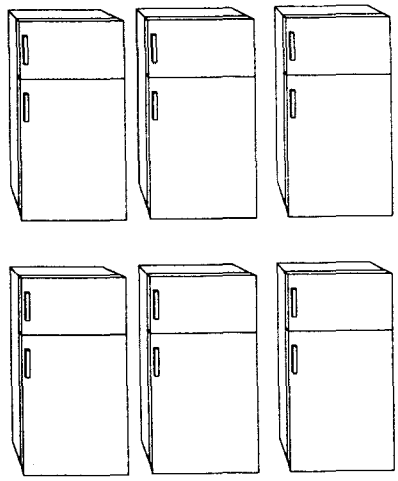
DSM Measure No. 1

Without SO_2 Costs



11,000 Participants
2,200 MWh saved/yr

With SO_2 Costs



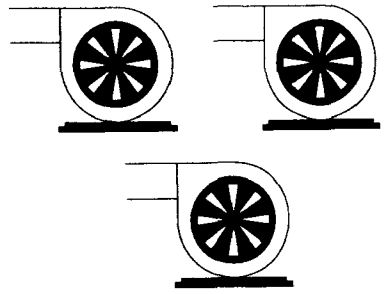
12,000 Participants
2,400 MWh saved/yr

DSM Measure No. 2

Without SO_2 Costs

0 Participants
0 MWh saved/yr

With SO_2 Costs



5,000 Participants
250 MWh saved/yr

supply-side efficiency measures being considered. A higher avoided cost will increase the number of supply-side measures considered to be cost-effective.

Supply-side efficiency measures can avoid the surrender of allowances under the avoided emissions incentive and the Reduced Utilization provision. However, these measures do not qualify for earning bonus allowances from the Reserve. Like demand-side efficiency measures and renewable energy projects, supply-side efficiency measures can avoid SO_2 emissions by offsetting generation from sulfur-emitting sources. The avoided SO_2 emission costs can make supply-side measures that are already cost effective to be more so. Likewise, measures that were not previously viable may now become cost-effective.

D. Renewable Energy Projects

1. Overview

Avoided SO_2 emission costs can affect renewable energy projects by increasing:

- The number of renewable energy resource options that are cost-effective,
- The size of the projects, and
- The payments for purchased power and improving the project economics for independent power producers.

In an integrated resource planning context, screening and selecting renewable energy resources follow much the same pattern as demand-side management programs. Utilities must develop and implement plans to serve energy needs. Renewable energy options must be examined and compared to other resource options for overall cost-effectiveness. Avoided SO_2 emission costs must be included to capture the full avoided cost of the renewable energy resource.

Renewable energy resources are typically developed in the following stages.

1. Potential renewable energy resources are identified and the energy production potentials are estimated.
2. The potential renewable resources are screened to determine cost-effectiveness using avoided cost values. The economic screen compares the cost of each option to the avoided cost of supply being replaced.
3. Options that pass the economic screening are implemented either by the utility or a non-utility generator.

Renewable resource options may be developed by the utility or through non-utility generators who then sell the power to the utility. The utility's avoided costs are a major determinant to the buyback rate for non-utility generators. Power purchases under PURPA (Public Utility Regulatory Policies Act) are priced at the avoided costs of the purchasing utility. Customer-owned renewable energy projects are also possible. Such self-generation may offset the

customer's own energy use or be sold back to the utility grid.[16]

2. Impact on Project Size and Screening

Avoided costs affect both the number of renewable energy options passing the economic screening process and the optimum size of the project. As with energy efficiency resources, the inclusion of the avoided SO_2 emission cost may change the viability of projects which were previously not cost-effective. Those projects already cost-effective will become even more so.

From the utility perspective, the inclusion of avoided SO_2 emission cost may be sufficient to select a renewable energy option. With utility-owned resources the utility directly receives the cost and SO_2 emissions benefits.

The utility may also accept renewable energy project proposals offered by independent power producers. In this case, avoided costs can help determine the terms of the purchase agreement. The buyback rate will increase with the addition of avoided SO_2 emission costs. The increased buyback rate will improve the project viability for the independent power producer, and may induce additional and/or larger project proposals.

3. Impact on Independent Power Producers

Avoided SO_2 emission costs may have a significant impact on independent power producers. These non-utility generators are competing to build and operate electric generating facilities at costs lower than the electric utility's conventional generation. The utility's buyback rate for an independent power producer depends on the utility's avoided costs.

Example: Utility Renewable Energy Project

Renewable energy resources are increasingly becoming components of utility bulk generation. In other instances, renewable energy resources are the most cost-effective options for specific applications. One such application is the use of modular renewable energy systems for remote locations. Such systems avoid the costly construction of distribution lines over long distances.

For example, a potential customer locates miles away from the nearest utility power supply. When evaluating the customer's options for electricity, the utility calculates that in addition to the utility's normal avoided costs of 6.5 cents per kWh (including 0.1 cents per kWh for avoided SO_2 emission costs), the cost of the service extension would be 4.1 cents per kWh.

Photo courtesy of the Solar Energy Industry Association

The total avoided cost for that customer would be 10.6 cents per kWh, which is the same as the estimated cost of a solar photovoltaic system with storage and inverters constructed on-site and not connected to the utility network. The utility and customer both opt for the photovoltaic system.

The income received by the independent power producer must cover the amortization of the power generating plant and operating and maintenance expenses as well as provide a margin of profit. As illustrated below, a small increase in buyback rates can result in a large increase in the independent power producer's profit margin. Since profit is what remains after all expenses are paid, even a small increase in buyback rates can greatly increase profits for a project with set expenses.

The improved profitability will attract more independent power producers to submit proposals as well as encourage those already making proposals to increase the number and size of projects. The size of proposed projects is often limited by the availability of financing and capital. Higher buyback rates will enhance profitability and will improve the ability of independent power producers to raise capital needed for expanded project proposals.

Thus, including avoided SO_2 emission costs can lead to increases in the size and number of renewable energy projects offered by independent power producers.

Example: Effect of SO_2 on Profitability

Consider an independent power producer proposing a project with the expenses and power sales shown in Table IV-4. Assume that the utility buyback rate for purchased power was at the avoided cost for Utility A described in Table IV-2.

The estimated revenue from the project is greater if buyback rates include the avoided SO_2 emission cost. However, because the costs of production remain unchanged, the profits increase at an even greater rate. In this example, a 3 percent increase in the avoided costs (due to avoided SO_2) results in a 12 percent increase in profits for the independent power producer (IPP).

E. Bidding

1. Overview

Bidding is the mechanism by which a utility can acquire supply and demand-side resources in a competitive fashion. Avoided SO_2 emission costs may affect the bidding process and increase the number and scope of competitive bids for energy efficiency and renewable energy resources.

The utility's procurement process may be limited to supply-side or demand-side projects, or may be an open "all-source" bidding request. Often a utility will publish its avoided cost as a target for potential bidders. By knowing the utility's avoided costs, a bidder can determine if the project is sufficiently competitive to proceed with the often costly process of developing a proposal.

Generally, a utility receives sealed proposals from project developers and selects projects based on cost and other criteria. A contract between the utility and the successful bidder(s) must then be negotiated. Once terms are set, the project is implemented.

2. Impact of Avoided SO_2 Emission Costs on Bidding

Inclusion of avoided SO_2 emissions costs can affect the bidding process in at least three ways. First, avoided costs may be published prior to the

Table IV-4
Effect of Avoided SO_2 Emission Costs on IPP Profitability

Annual Costs:

Amortization of Capital:	$5,100,000
O&M Expenses:	$3,200,000
Annual Sales:	211,000,000 kWh

	Without SO_2 Costs	With SO_2 Costs
Buyback rate ($/kWh)	.0513	.0528
Revenue ($)	10,833,000	11,150,000
Profit ($)	2,559,000	2,876,000

solicitation of bids for resource projects. Increasing the avoided cost should result in a greater number of competitive bids being submitted, as more projects become competitive with the utility base plan.

Second, avoided costs will also affect the evaluation of bids. The full value of avoiding utility supply capacity should be considered in bid evaluation. Thus, when the utility is reviewing bids, the utility should include the avoided SO_2 emission cost in the cost criteria. Other criteria may include risk and reliability factors and other environmental impacts.

Third, avoided costs will affect the actual negotiation of the contract for the resource. Avoided costs will be part of the overall balancing of interests between economic factors, risk, reliability, and environmental factors. These costs may also be part of an indexed payment strategy, or as a re-opener clause to a fixed payment strategy. To the extent that avoided costs enter the negotiations, the inclusion of avoided SO_2 emission costs can result in increased payments to the bidder.

F. System Dispatch

1. Overview

Dispatch refers to the selection process by which generating units are chosen to serve electrical loads at a particular time. The electrical loads are not constant throughout the day; loads usually fall to a low during the late night or early morning hours, and increase to a maximum during the afternoon hours when customers are most active.

As loads increase during the day, the utility must increase the output of generating units already on-line, or bring additional units on-line, to serve the loads. When loads decrease, the utility must reduce the level of generation by taking units off-line and/or backing down the level of output from units already on-line.

Major Components of a Resource Bid

Utility requests for proposals for energy resources can be quite detailed and complicated. Some utilities provide forms to prospective bidders as part of the request for proposals. These forms require summary information describing the project, schedules, and other attachments. Some utilities even require that the bidders complete a project evaluation work sheet in which bidders score their proposals in accordance with a set of instructions.

The major categories of information that could be included in a resource bid and/or bid evaluation are:

- Project description, including resource type, size, fuel type, date of availability, and life of the offered resource.
- Energy and capacity offered, by time of day, season, and year.
- Price bid, including capacity and energy charges, escalation rates, cost indices, and proposed payment schedule.
- Environmental emission levels and other effects calculated both for the project and net of utility plant emissions being offset.
- Technical feasibility and risk assessment, including maturity of technology, operating experience of the bidder, completeness of engineering design, progress toward securing needed licenses and permits, and proposed quality control.
- Economic viability of proposer and project, including capital structure, security of financing, public acceptance of project, and years until project breaks even.
- Project persistence, including maintenance practice, fuel security, and proposer experience.
- System compatibility, including dispatchability, fuel diversity, appropriateness of size, and location.
- Estimate of the avoided costs of utility supply, including avoided SO_2 emission costs and perhaps avoided costs of external impacts.
- Estimate of benefit cost ratio.

Utilities dispatch generating units according to *economic dispatch* to minimize the operating cost of the utilities' systems. Plants with lower fuel and variable operating and maintenance costs per kWh are brought on-line and loaded to full output before units with higher operating costs. Generating units with low fuel costs, low heat rates (less heat input per kWh output), and low variable operating and maintenance costs tend to be called upon sooner, loaded more heavily, and taken off-line later than other units. Fixed costs (e.g., the cost of building the generating unit) are sunk costs -- incurred whether the unit is called upon to operate or not -- and do not enter into the dispatch decision.

Until recently, SO_2 emissions were considered externalities, costs that are imposed upon others but for which a business does not pay. Thus, SO_2 emission rates were not considered in economic dispatch. However, the creation of the SO_2 allowance market under the Clean Air Act Amendments has added the cost of SO_2 allowances to the costs directly incurred by the utility.

Analysts developing or evaluating utility plans must be careful to include the cost of SO_2 allowances in the economic dispatch of the utility system being modeled. Failure to include allowance costs in the dispatch model can result in higher emissions, higher compliance costs, and higher operating costs.

2. Impact of SO_2 Emission Allowances on Dispatch

Consider a utility that needs additional allowances to meet compliance requirements. The utility could reduce SO_2 emissions at an existing plant by fuel switching, scrubbing, purchasing excess allowances at market cost, or employing efficiency and renewable energy. In either case, the utility will face a cost in meeting allowance obligations.

Conversely, the allowances the utility expends through the dispatch of the utility's system dispatch have a value. *By including the market value of an allowance in the economic dispatch algorithm, generating units would be dispatched to minimize the combined cost of fuel, variable operating and maintenance, and SO_2 allowances.* SO_2 costs would be included in economic dispatch for each unit at the time the unit becomes subject to Title IV.

A utility with excess allowances is not facing increased system operating costs. However, a market exists to sell allowances. This market gives the utility an opportunity to reduce operating costs by selling excess SO_2 allowances. Again, including the market value of an allowance in the economic dispatch algorithm will appropriately dispatch units to minimize overall utility production costs.

In both examples, the costs of SO_2 allowances are real costs, or real opportunities for reducing costs, faced by utilities. The SO_2 allowance market has established a cost for the SO_2 emitted which is every bit as real as the fuel cost for the plant. The utility needs to acquire the allowance just as it needs to purchase fuel.

The allowance concept distinguishes SO_2 from other regulated and

unregulated pollutants. Other regulated pollutants are regulated solely on the basis of emission rates, meaning that more tons of pollutant can be released as more plants are built. (The exception is for plants that are being built in non-attainment areas where offsets for the emissions would be required.) Unlike other regulated pollutants, and all unregulated pollutants, the limits on total SO_2 emitted creates a market value for SO_2.

Example: The Failure to Include SO_2 in Dispatch

Consider the effect of failing to include SO_2 allowance costs in the dispatch algorithm for Utility A, the moderately-sized high-sulfur-coal-burning utility. In this hypothetical situation, the utility failed to add the market price of $200 per allowance for SO_2 emissions to each unit's fuel and operating costs when dispatching. This hypothetical situation is compared to one in which the utility applied a cost of $200 per SO_2 allowance to each unit's SO_2 emissions.

SO_2 emissions are substantially higher when SO_2 emission costs are not included in the dispatch algorithm. Including SO_2 emission costs in dispatch resulted in the emission of almost 300,000 fewer tons of SO_2 over the 15 year period beginning in 1995. By comparing operating cost differences between the two cases, one finds that this SO_2 reduction was accomplished at an average cost of $43 per ton.

3. Impact on Dispatchable Renewable Energy Resources

The ability to dispatch energy resources allows the utilities to increase or decrease electrical supply to loads demanded by customers. Conventional fossil-fired utility generation is dispatchable; the utility has control of the resource's availability. The utility has flexibility to choose which plants serve the load. The utility can use that flexibility to respond to varying conditions such as power plant outages, the amount of power demanded, transmission network constraints, and environmental regulations on plant operation.

Some forms of alternate resources do not give the utility the ability to dispatch. Sometimes this condition is a function of the physical process used to produce electricity; solar and wind energy systems are examples. However, the availability of these resources can often be predicted with a high degree of certainty. Storage technologies are being developed to cost-effectively store the energy generated from these resources. In general, though, solar and wind energy resources are not considered dispatchable.

Many forms of renewable energy are dispatchable. Biomass systems in which wood, plant, or other organic material can be stockpiled until converted to electricity are dispatchable. Geothermal systems in which steam can be withdrawn as needed are dispatchable. Hydro electric systems in which stored water is the primary energy source are also dispatchable. In such instances, the avoided SO_2 emission costs should be considered in the dispatch of these resources. *Including the avoided SO_2 emission costs will act to increase the use of dispatchable renewable energy resources.*

The following example illustrates that dispatchable renewable resources can displace conventional generation to reduce SO_2 emissions.

Example: Utility-Owned Geothermal Unit

Assume that a utility builds a 200 MW geothermal unit at a capital cost of 5.0 cents per kWh and an 80 percent capacity factor. Because there is no fuel cost, overall operating and maintenance costs are an additional 1.0 cents per kWh. Other coal-fired units on the utility's system have operating costs (including avoided SO_2 emission costs of 0.1 cents per kWh) ranging from 2.1 cents to 2.9 cents per kWh. Because the cost to build generating units is a sunk cost, it does not enter into the dispatching decisions.

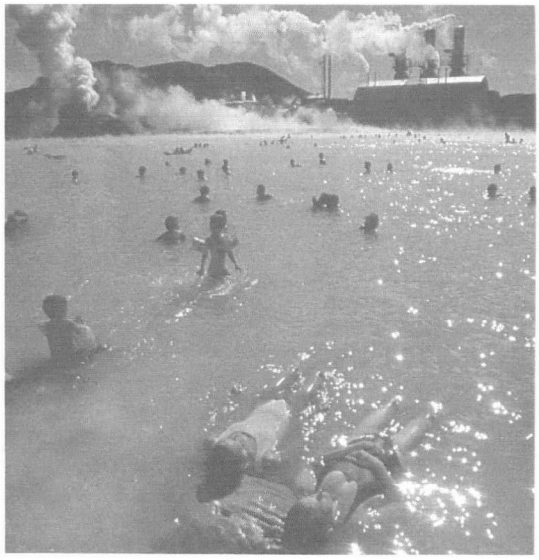


Photo courtesy of the Icelandic Tourist Bureau

The coal-fired units follow in the same dispatch order as prior to the addition of the geothermal unit. The units at the bottom of the loading order (last to be dispatched) are displaced by the geothermal unit. SO_2 emissions from those units are avoided to the extent that unit energy output is decreased by the new geothermal unit. Table IV-5 summarizes these results.

Table IV-5
Effect of Renewable Energy Resource on Dispatch Order

	Before Geothermal 1			After Geothermal 1		
	Dispatch Priority	Variable O&M and Fuel (Cents/kWh)	SO_2 Emissions (Tons)	Dispatch Priority	Variable O&M and Fuel (Cents/kWh)	SO_2 Emissions (Tons)
Geothermal 1	N.A.	N.A.	N.A.	1	1.0	0
Coal 1	1	2.1	3500	2	2.1	3500
Coal 2	2	2.15	4000	3	2.15	3950
Coal 3	3	2.4	2500	4	2.4	1100
Coal 4	4	2.9	1500	5	2.9	300
		Total SO_2	11500		Total SO_2	8850

Part V

Beyond SO_2: Other Pollutants

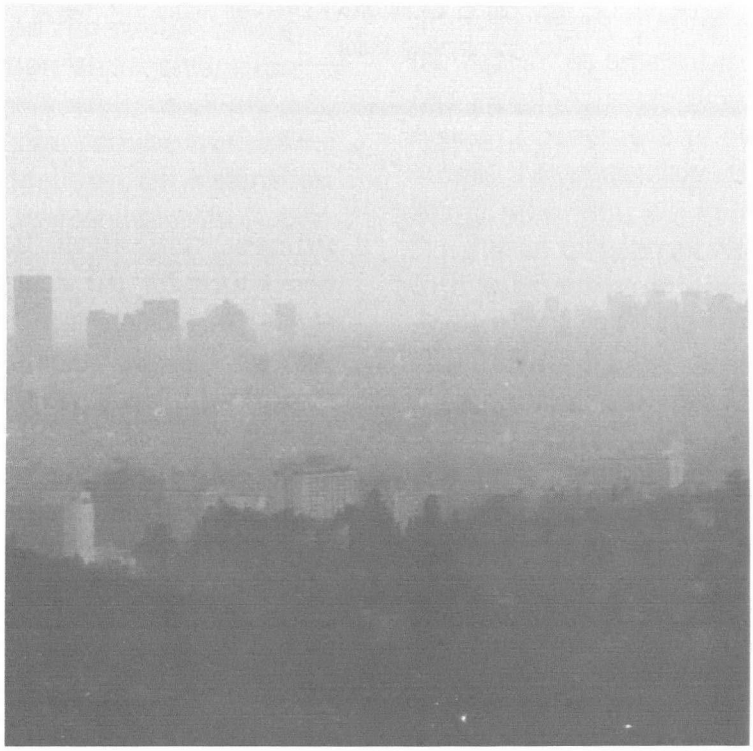


Photo courtesy of Woodfin Camp

Efficiency and renewable energy not only help utilities avoid SO_2 emissions but other pollutants as well, including NOx, CO_2, toxics, and particulates. Efficiency and renewable energy resources can provide a cost-effective strategy against the risk of future environmental regulation.

This part discusses the following topics:

A. Applying the Handbook's concepts to other pollutants
B. Considering the impact of externalities on avoided costs
C. Using efficiency and renewable energy as a pollution prevention strategy to minimize risks

Sulfur dioxide is not the only pollutant of concern stemming from electric utility operation. Electric utilities also emit nitrogen oxides, carbon dioxide, toxics, and particulates as well as produce ash and scrubber sludge. Not all of these pollutants are applicable to tradeable emission programs; nor are all of these pollutants even currently regulated. However, the consideration of these pollutants when formulating SO_2 strategies may still be a cost-effective course of action. The following table indicates the approximate share of national emissions from electric utilities:

Pollutant	Share of National Emissions by Electric Utilities
SO_2	69%
CO_2	35%
NOx	32%
Particulates	5%

The Clean Air Act includes restrictions on most major air pollutants emitted by electric utilities. In addition to the SO_2 emission allowance system, Title IV of 1990 Clean Air Act Amendments also established new regulations for nitrogen oxides (NOx) emitted from utilities. Title III of the Act contains provisions for the study of utility emissions of airborne mercury and other toxics. Title I of the Act addresses a range of pollutants such as SO_2, NOx, and particulates from the perspective of ambient air standards.

Carbon dioxide (CO_2) is not a regulated pollutant. However, CO_2 is a major focus of several international efforts to reduce greenhouse gas emissions. The Climate Change Treaty as signed by the United States during the 1991 Earth Summit in Rio de Janeiro is one such instrument. On Earth Day 1993 President Clinton reaffirmed the United States' commitment to meeting the Climate Change Treaty. This commitment includes stabilizing greenhouse gases at 1990 levels by the year 2000. To support this effort, the U.S. has developed "The Climate Change Action Plan," a program of 50 actions designed to reduce greenhouse gas emissions across all sectors.

The procedures and issues discussed in this Handbook are relevant to these other pollutants in several ways. First, if emission trading systems or other economic incentive programs are

developed for other pollutants, analogous calculations for compliance costs and resource cost-effectiveness will apply. Second, States that develop monetary values for environmental externalities may find some of these calculations and procedures useful. Finally, to calculate the full benefits of energy efficiency and renewable energy as pollution reduction strategies, utilities and regulators should consider how these technologies can reduce multiple emissions. One important consideration is the use of these technologies to hedge the cost risks of possible future environmental regulations.

A. Applying the Concepts to Other Pollutants

As with SO_2, efficiency and renewable energy resources help avoid NOx, CO_2 and other emissions simply by reducing a utility system's generation from fossil fuel sources. If economic incentive programs are developed for these other pollutants, the concepts introduced in this Handbook may prove useful.

Reduction of ambient nitrogen oxide emissions may be the next compliance area in which energy efficiency and renewable energy can play a role. NOx is an important precursor of tropospheric ozone (urban smog) a pollutant that affects dozens of cities and towns in the United States. Under Title I of the Act, regions that exceed national ambient air quality standards (NAAQS) must take actions to reduce their emissions. These "non-attainment" regions are classified as either extreme, severe, serious, moderate, or marginal depending upon the degree of the problem. Compliance dates range from 1993 to 2010 based on the non-attainment status.

The Clean Air Act Amendments of 1990 encourage the use of market-based economic incentive programs in areas of the country that exceed national ambient air quality standards (NAAQS). In several parts of the country, regulators are developing these types of programs to control NOx emissions. Most notably, the South Coast Air Quality Management District in Southern California will launch NOx and SOx emissions trading systems in early 1994. The South Coast region is classified as an extreme non-attainment area for ozone and its NOx program will cover approximately 390 facilities. Each facility will receive an annual allocation of tradable emissions credits similar to Acid Rain allowances. The number of annual credits allocated to utilities will be reduced over time so that by 2003 there will be an overall reduction of 75 percent.[17]

Title I NOx trading is also under consideration in Massachusetts and several other States that make up the Northeast Ozone Transport region. In addition, State and regional governments are exploring the use of NOx trading to address non-attainment areas in Illinois and Houston, Texas.

As noted in the case of SO_2 emission trading, the associated emission costs for these programs will affect the avoided costs of fossil-fired generation. In turn, increased avoided costs for fossil-fired generation will improve the viability of efficiency and renewable energy resources in project design and screening, bidding, and dispatch.

B. Externalities

1. Overview

A number of states have begun to consider the environmental costs of emissions through "environmental externalities." These externality values are incorporated into the traditional benefit-cost analysis and used in integrated resource planning.

Some states have placed a specific monetary value on a given pollutant (in terms of $/ton or similar units). In other instances, states have adopted a more general "adder" to the costs of conventional fossil and/or nuclear generation technologies (typically a "percentage" credit or debit added to the estimated costs of a new unit). Table V-1 summarizes the values given to eight common air pollutants by three jurisdictions that have attempted to quantify the emission impacts.

Example: Externalities Add to Avoided Costs

Table V-2 illustrates the effect of including the externality values approved by the Massachusetts DPU on an example utility's avoided costs.

In this example, a total of 4.29 cents would be added to the utility's avoided costs to account for the eight identified externalities.

2. Impact on Cost-Effectiveness

Like avoided SO_2 emission costs, environmental externality values improve the cost-effectiveness of efficiency and renewable energy resources relative to conventional fossil fuel and nuclear technologies. Externality values effectively increase a utility's avoided costs for conventional energy generation technologies. Consequently, more efficiency and renewable energy technologies may be cost-effectively added to the utility's resource portfolio.

Higher avoided costs caused by the incorporation of the costs of one or more emissions now considered externalities could affect the utility planning process in a variety of ways. These impacts would parallel those discussed for SO_2; these impacts include resource screening, program design, bidding, and dispatch.

In addition to improved cost-effectiveness, externality values can also affect incentive levels and customer participation. With the higher avoided cost, the utility would be able to offer more attractive incentives to improve program penetration.

3. Impact on System Dispatch

Historically, system dispatch has been conducted on a strictly *economic* basis; dispatch has included only costs directly incurred by the utility. As such, environmental impacts associated with power plant emissions generally have not been factored into dispatching decisions, unless environmental regulations constrain the availability of certain generating units to produce electricity. Some analysts have argued that power plant emissions create a burden on and cost to the rest of society, and that utilities can reduce these societal costs by including an emission cost in their dispatch methods.

Table V-1
Environmental Externality Values

Pollutant	Massachusetts (Docket 89-239) 1989 $/ton	Nevada (Docket 89-752) 1990 $/ton	California (PUC) 1990 $/ton
Nitrogen Oxides (NO_x)	$6,500	$6,800	$13,060
Sulfur Oxides (SO_x)	$1,500	$1,560	$12,960
Volatile Organic Compounds	$5,300	$1,180	$3,660
Total Suspended Particulates	$4,000	$4,180	$8,780
Carbon Monoxide (CO)	$860	$920	NA
Carbon Dioxide (CO_2)	$22	$22	$8
Methane (CH_4)	$220	$220	NA
Nitrous Oxide (N_2O)	$3960	$4,140	NA

The *environmental dispatch* method thus adds emission rates to the factors considered in economic dispatch algorithms (fuel costs, heat rates and variable operating and maintenance costs) to determine the priority in which generating units are loaded. Environmental dispatch is a means of incorporating external environmental costs into dispatching decisions.

Using an environmental dispatch scenario, an analyst could determine a pollutant's effect on the dispatching of generating units. In other words, the analyst could see the impact on emission levels from dispatching generating units as though these pollutants had a direct cost to the utility. The direct cost for purposes of the dispatching study could be an assumed price of a pollution allowance if a market existed, or it could be based on perceived environmental harm to society.

Table V-2
Effect of Externalities on Avoided Costs

Pollutant	Mass DPU Value (1989 $/ton)	System Marginal Emissions (lb/MWh)	Cents/kWh (1991)
NO_x	$6,500	5.1	1.66
SO_x	$1,500	10.6	0.80
VOC	$5,300	0	0.00
TSP	$4,000	0.3	0.06
CO	$860	0	0.00
CO_2	$22	1,620	1.78
CH_4	$220	0	0.00
N_2O	$3,960	0	0.00

Example: Environmental Dispatch with NO_x

Consider assigning costs to the NO_x emissions of Utility A and dispatching the system taking those costs into account. To determine the effect of NO_x emission costs on unit dispatch, a range of NO_x emission costs from $1,000 per ton avoided to $10,000 per ton avoided was analyzed using a production-simulation model. At $1,000/ton, over the 15 year period of analysis, NO_x emissions decrease by 57,500 tons at an average cost of $380 per ton due to environmental dispatch. At $10,000/ton, over the 15 year period of analysis, NO_x emissions decrease by 107,700 tons at an average cost of $990 per ton due to environmental dispatch.

(continued)

In both the high- and low-cost NO_x scenarios, environmental dispatch resulted in decreases in both NO_x and SO_2 emissions. However, SO_2 emission levels became more unstable and rose as NO_x prices became larger and began to dominate the dispatch. This illustrates that pollutant control strategies should be developed in an integrated manner so that gains made in the control of one are not unexpectedly lost when the focus changes to control another.

Although this example is done for NO_x, it is applicable for any pollutant for which an allowance market does not exist, i.e., any unregulated pollutant or any emission-rate-regulated pollutant. If another pollutant were to be used, the appropriate emission rate for each generating unit and the appropriate "allowance" value would have to be substituted in the production-simulation model.

C. Using Efficiency and Renewable Energy to Reduce Regulatory Risk

Conventional compliance options such as scrubbing and fuel switching often address pollutants in isolation. For instance, scrubbing technologies that capture SO_2 emissions may not reduce other pollutants such as NOx. Such technologies may even increase the output of other pollutants.[18] Separate control technologies may be required for each pollutant.

Conversely, efficiency and renewable energy technologies will reduce or avoid virtually all pollutants. When developing compliance options, the regulatory costs should be considered on an integrated basis. A pollution prevention strategy may be particularly useful for hedging the risks of possible future environmental requirements. Efficiency and renewable energy technologies may be part of a voluntary "no regrets" strategy against changes in existing regulations or the development of new legislation for presently uncontrolled pollutants.

The voluntary reduction of CO_2 and other greenhouse gases is the cornerstone of the recently announced U.S. Climate Change Action Plan. One component of the plan, "The Climate Challenge," is a program in which electric utilities are voluntarily committing to CO_2 reductions. The success of such voluntary stabilization efforts will be reviewed every two years by an action plan task force. Further, the Action Plan directs an interagency task force to explore longer term strategies to address CO_2 beyond the year 2000. Depending upon the success of the voluntary actions and the strategies for longer term actions, other greenhouse gas actions are possible. Efficiency and renewable energy help utilities prepare for any contingency.

UTILITY PROFILE
New England Electric System

Since its first programs were launched in 1987, New England Electric System (NEES) companies continually to establish new environmental initiatives that reflect a commitment to providing electric service in an environmentally sustainable way. The NEES companies have developed a broad mix of energy efficiency and renewable energy efforts, and boast one of the country's largest demand-side management programs (DSM), relative to its size.

The NEES companies have initiated efficiency programs that will save as much energy as produced by a large fossil-fuel generating unit. Residential DSM programs include appliance recycling, electric space heat conversions, energy efficient home construction, lighting retrofits and more. NEES' commercial and industrial DSM programs promote efficient design and construction practices.

NEES Appliance Recycling Program

In collaboration with the Conservation Law Foundation, NEES developed NEESPLAN 4, a plan that reaffirms energy efficiency and renewable energy investment as environmentally responsible initiatives and key components to minimize customer costs and reduce future environmental risks. In 1992 NEES generating subsidiary New England Power Company announced that it will purchase 36,000 kilowatts of electricity from seven renewable energy plants. Projects include the company's first major windpower project, as well as landfill methane, municipal solid waste, waste heat to generate electricity. The projects are estimated to reduce greenhouse gas emissions by over 500,000 tons (carbon dioxide equivalents) per year and will reduce smog precursor emissions by over 460 tons per year. These renewable initiatives will help NEES reach its goal of reducing net emissions of carbon dioxide and other greenhouse gases by 20% from 1990 levels by the year 2000, and stabilizing at that reduced level in the post-2000 period.

NEES also works internationally to offset greenhouse gases. One pilot project involves working with a Malaysian timber harvesting firm to improve its harvesting practices so that more unharvested trees survive, leaving more of the forest intact. This project is expected to economically offset 300,000 to 600,000 tons of carbon dioxide.

NEES' efforts take on special importance as New England faces stringent emission reduction requirements under the Clean Air Act amendments. These environmental investments will help NEES position itself to comply, not only with requirements flowing from the 1992 Earth Summit agreement to stabilize greenhouse gas emissions, but with EPA's Clean Air Act regulations including the Acid Rain Program. Two NEES companies, Massachusetts Electric and Granite State Electric, were already awarded 103 bonus SO_2 allowances from the Conservation and Renewable Energy Reserve. The companies were rewarded for their efficiency efforts and a landfill methane renewable energy project. Based on current estimates of future DSM energy savings and renewable energy additions, the NEES companies expect to be eligible for a total of 14,000 allowances from the Reserve through 1999.

In addition to global and national opportunities for investment in pollution prevention, there are local prospects as well. For example, NEES plans to participate in the new Massachusetts Emission Reduction Credit (ERC) banking and trading program. The ground-breaking ERC program allows inventoried sources of NOx, VOCs and CO in Massachusetts to earn bankable and tradeable credits by reducing emissions before or below regulatory requirements. Potentially credit-earning activities include utility DSM and renewable energy.

Conclusion

Photo courtesy of U.S. Department of Interior

The market-based benefits of the Clean Air Act incentives are ideal inputs for integrated resource planning. By incorporating these benefits into the planning process the true economic competitiveness of energy efficiency and renewable energy is more fully realized.

This Handbook described the unprecedented opportunities offered by the Clean Air Act Amendments of 1990 for utilities to use energy efficiency and renewable energy programs in their air pollution compliance strategies. In addition to the built-in incentive of saving allowances through avoided emissions, the Clean Air Act provides two other special incentives--the Conservation and Renewable Energy Reserve and Reduced Utilization.

Two Ways to Consider the Benefits

As discussed in this Handbook, the link between energy efficiency and renewable energy and acid rain compliance for electric utilities is important for two reasons. First, these technologies can be part of a least cost compliance strategy. For some utilities, efficiency and renewable energy may complement other compliance options such as fuel switching, co-firing with natural gas, or allowance trading. Ultimately, utilities should explore the synergies between all compliance options to find the least-cost portfolio.

Second, the SO_2 reduction benefits of efficiency and renewable energy can make these energy resources more cost effective and can even turn non-cost effective programs into viable ones. The quantifiable costs of generating SO_2 feed directly into electricity planning mechanisms such as cost effectiveness tests, program design, bidding schemes, and buyback rates. Even in States where the inclusion of environmental externalities in resource planning decisions is controversial, the inclusion of the market-based costs of SO_2 emissions in resource decisions should be acceptable to State regulators.

Beyond SO_2

The methodologies outlined in this handbook may be easily adapted to calculate the quantities and impacts of emissions other than SO_2. In some areas of the country, avoided NOx emissions may soon provide an additional market-based incentive for energy efficiency and renewable energy. In addition, States with externality values may use the method outlined in the Handbook to calculate the avoided emissions of additional pollutants.

Integrated Resource Planning is the Key

Integrated Resource Planning (IRP) provides an ideal mechanism for utilities and state regulators to develop and evaluate acid rain compliance strategies. Even where the value of saved or earned allowances has only a modest effect on the cost effectiveness of renewable energy or energy efficiency resources, compliance planning should incorporate many of the same qualitative variables necessary for good resource planning. Factors such as diversity and modularity of technology and the consideration of risk are as important for compliance planning as they are for resource planning. These factors, which may have a big impact on *future* costs faced by a utility and its ratepayers, often favor the use of energy efficiency and renewable energy.

Finally, the extent to which utilities receive the emission reduction benefits of energy efficiency and renewable

energy will depend upon the policies of state regulators toward these technologies. Special bonus allowances for energy conservation and renewable energy are available only to utilities that have implemented least cost integrated resource planning. In addition bonus allowances for energy efficiency programs only will be awarded to utilities whose state regulators have taken measures to make conservation profitable. These eligibility requirements do not apply to utilities seeking to save allowances through avoided emissions. However, utilities in States that lack these regulatory reforms are not likely to pursue energy efficiency and renewable energy resources and to benefit from their emission reductions.

Endnotes

1. These reductions are relative to 1980 emission levels. The reductions will be achieved incrementally beginning in 1995 and reaching targeted levels by 2010.

2. Units affected by Phase I are allocated allowances equal to the average of the 1985-87 heat input multiplied by a 2.5 lbs SO_2/mmBtu emissions rate. Phase II allocations are derived from this baseline times a 1.2 lb SO_2/mmBtu.

3. Electric Power Research Institute, *Integrated Analysis of Fuel, Technology and Emission Allowance Markets: Electric Utility Responses to the Clean Air Act Amendments of 1990*, Report no. TR-102510, August 1993, p. 1-20.

4. National average emission factors - 1990 (per kWh sold)

Fuel type	Percent of Generation	CO_2 (lb/kWh)	NOx (lb/kWh)	SO_2 (lb/kWh)
Coal	53%	2.4	0.0088	0.017*
Fuel Oil	4%	2.0	0.0042	0.012
Gas	9%	1.3	0.0046	0
Other	34%	0	0	0
National Average		1.5	0.0055	0.0099

* SO_2 emission rate for coal is an average of the 1990 value of 0.022 lb/kWh and a projected 2000 value of 0.012 lb/kWh.

5. US EPA, *Conservation Verification Protocols*, Document no. EPA 430/8/B-92-002, March 1993. Also, California Public Utility Commission, *Protocols and Procedures for the Verification of Costs, Benefits, and Shareholder Earnings from Demand-Side Management Programs*, October 29, 1992. Also, New Jersey Board of Regulatory Commissioners, *Measurement Protocol for Commercial, Industrial and Residential Facilities*, April 28, 1993.

6. US EPA, *The User's Guide to the Conservation Verification Protocols*, Document No. EPA 430-B-93-002, April 1993.

7. Net income neutrality applications should be sent to: U.S. Department of Energy, EE-14, 1000 Independence Ave., SW, Washington, DC 20585.

8. On November 18, 1993 EPA proposed some revisions to the Reduced Utilization requirement. These revisions are expected to be finalized in the spring of 1994. For more information see 58 *Fed. Reg.* 60950, November 18, 1993.

9. If the utility shifted a portion of the generation to sources outside of the utility's system, then allowances for that portion must be surrendered at the average emission rate for the NERC region.

10. In general, sulfur-free generation includes renewable energy resources. However, in certain cases, such as some forms of geothermal and biomass production, the resource may not qualify as sulfur-free generation. This distinction between renewable energy generation and sulfur-free generation only applies to the Reduced Utilization provision.

11. U.S. Environmental Protection Agency, *Conservation Verification Protocols*, EPA 430-8-B-92-002, March 1993 and *The User's Guide to the Conservation Verification Protocols*, EPA 430-B-93-002, April 1993.

12. This determination is made after adjusting for any system-wide sales declines and any shifts to compensating units.

13. This weighted-average heat rate is only an approximation. The Reduced Utilization provision actually requires the kWhs from energy efficiency and sulfur-free generation to be converted by the heat rate of a specific Phase I unit. Thus, in order to maximize the benefits of energy efficiency and sulfur-free generation, the utility would assign these resources to the Phase I unit with the greatest heat rate.

14. Also see: Alliance to Save Energy, *Impacts of Demand-Side Management Programs on the Environment*, June 1993, Washington, DC.

15. If the utility shifted a portion of the generation to sources outside of the utility's system, then allowances for that portion must be surrendered at the average emission rate for the NERC region.

16. Because retail rates are often higher than the avoided costs, customers who self-generate can benefit more by offsetting their own energy use. The avoided SO_2 emission cost may not be relevant if the renewable generation is only for the customer's own use. However, customer self-generation projects will often combine self-use with the sale of excess power to the utility grid. For these combined-purpose projects, utility avoided costs may affect project viability and project size.

17. For a complete description of the RECLAIM program, see RECLAIM, Development Report and Proposed Rules, Volume I, October 1993.

18. The increased energy demand for the control technology may increase the net emissions of other gases such as CO_2.

Appendix A

Production-Simulation Modelling

Data Needed for Typical Production-Simulation Model

- ✓ Monthly load shapes
- ✓ Annual peak and energy forecast
- ✓ General and fuel escalation rates
- ✓ Existing plant data: emissions, heat rates, capacity, fuel types, etc.
- ✓ Data on expected plant additions
- ✓ Annual changes to system (retirements, etc.)
- ✓ Seasonal capacity variations
- ✓ Purchases and sales data
- ✓ Scrubber data
- ✓ Cost of emissions ($/lb)
- ✓ Assignment of hours to time-of-use periods

Steps in a Parametric Analysis

Parametric analysis can be a useful tool in situations in which either the utility does not have efficiency and renewable energy programs already planned, or the analyst wishes to evaluate how changes in program load shapes or energy and capacity impacts would affect the levels of emissions that are avoided.

STEP 1:

Determine type of program(s) to model. The analyst might choose to model a typical complement of efficiency or renewable energy programs that includes some base-load, intermediate-load, and peak-reduction components. The analyst could also model individual programs of special interest, e.g., off-peak promotion, to determine their emissions impacts.

STEP 2:

Determine the level of capacity saved or generated. For example, a moderately aggressive DSM scenario for the near-term time horizon might be expected to decrease peak load by about five percent. Larger and smaller decrements can be used. Individual technologies or programs should be assigned a proportion of the savings.

STEP 3:

Develop a load shape reflecting the capacity and energy savings for each demand-side and renewable energy program. The load shape of the program depends on the characteristics of the technology included. Base, intermediate, and peak-reducing or generating technologies each possess their own unique load shape. Input to production-simulation model.

For each supply-side efficiency program, determine the change in heat rate expected as a result. Input changes to production-simulation model.

Publicly Available Data Sources for Production-Simulation Modeling

- Energy Information Administration, U.S. Department of Energy, Form EIA-767, "Steam-Electric Plant Operation and Design Report".

  Projected Fuel Consumption
  Plant Configuration
  Boiler Information
  Air Emission Standards and Design Parameters
  Plant Information
  Fuel Type and Consumption
  Generator Information
  Flue Gas Desulfurization Information

- Office of Energy Emergency Operations, U.S. Department of Energy, Form IE-411.

  Capacity Purchases and Sales
  Existing Generation Capacity
  Future Generating Capacity Installations, Changes, and Removals
  Actual and Estimated Net Energy and Peak Demand

- Federal Energy Regulatory Commission, FERC Form No. 1: Annual Report of Major Electric Utilities, Licensees, and Others.

  Plant Statistics (e.g. heat rate, net generation)

- Electric Power Research Institute, *TAG™ Technical Assistance Guide: Electricity Supply*

  General Plant Performance Data
  General Economic Factors

- Edison Electric Institute

  Load Data

Appendix B

Conservation and Renewable Energy Reserve Application Form

Acid Rain Program
Instructions for Conservation/Renewables Reserve Form
(40 CFR Part 73.80, 73.81, and 73.82)

The Energy Conservation and Renewable Energy Reserve Program provides a 300,000 allowance reserve for utilities employing qualified energy conservation measures or renewable energy generation. To apply for allowances from the Reserve, you must submit the Conservation/Renewables Reserve form.

EPA will accept submissions each July 1 following the year for which you are claiming energy savings or generation, beginning on July 1, 1993. Forms received before July 1 will be deemed to be received on July 1. EPA will accept Conservation/Renewables Reserve forms until it has allocated all 300,000 allowances or until the year 2010, when the Reserve will be terminated.

EPA will render a decision whether submissions meet the specified requirements within 120 days of receipt. If the applicant is a state rate-regulated, investor-owned utility and is undertaking conservation measures for the purpose of receiving Reserve allowances, EPA's approval will be conditional upon certification of net income neutrality by the Secretary of the U.S. Department of Energy. For a complete description of the Conservation and Renewable Energy Reserve allowance program mandated by Sections 404 (f) and (g) of the Clean Air Act Amendments, see 40 CFR Part 73.

Type or complete the form using black ink. If you need more space, add pages in the appropriate format or photocopy the pertinent page. When you have completed the form, indicate the page order and total number of pages *(e.g., 1 of 4, 2 of 4, etc.)* on each page in the spaces provided at the top right hand corner of the page.

STEP 1 Enter the name of the electric utility that is applying for the reserve allowances and list the state(s) in which the utility operates.

STEP 2 List the name and phone number of the person(s) EPA should contact for clarification.

STEP 3 To qualify for reserve allowances, the applicant, any subsidiary of the applicant, or any subsidiary of the applicant's holding company, must own or operate, in whole or in part, an affected unit. You need to list only one affected unit.

STEP 4 Applicants subject to the ratemaking jurisdiction of a State regulatory authority must use the verification methodology approved by such authority provided that the ratemaking entity uses performance-based rate adjustments (see 40 CFR 73.82(c)(1)).

All other applicants must submit documentation to EPA to verify savings; these applicants may use the EPA Conservation Verification Protocol. These applicants must submit the documentation with this form.

STEP 5 At "Type of measure or program," enter a descriptive name associated with the energy conservation measure or program. If a group of measures are combined for monitoring purposes, you may enter the overall name of the program. For instance, a group of energy savings measures you undertake in office buildings may be termed "Building Retrofit." For individual measures, use the terms given at 40 CFR part 73, Appendix A(1), if appropriate. You also may list a conservation measure not appearing in Appendix A, provided it meets the requirements of 40 CFR 73.81(a). List these measures using an appropriate term.

If you are using industrial waste gases as a conservation method, include documentation to illustrate that the use of such gases does not result in a net increase of sulfur dioxide emissions.

"Savings year" refers to the year for which you are claiming saving for the particular group of installations. For instance, if in 1997 you are applying for credit based upon conservation achieved in 1995, the savings year is 1995. You may claim multiple years of savings for a measure, but should list each year separately. **You must have installed measures on or after January 1, 1992, to receive credit.**

"Number of Installations" is the number of sites or devices installed with the conservation measure. This value represents the total number of installations in operation during the savings year.

Total the energy savings from each conservation method, including those listed on additional pages, in the "Total" box on the right hand side of the form.

STEP 6 This step converts the megawatt hours of generation saved to the tons of sulfur dioxide emissions avoided due to conservation measures, as follows:

$$\text{Tons of } SO_2 \text{ Avoided} = \frac{\text{Step 5 Total (MWh) x 4 (lbs/MWh)}}{\text{2000 (lbs/ton)}} = \text{Step 5 Total (MWh) X .002} \left(\frac{\text{tons}}{\text{MWh}}\right)$$

Round to the nearest tenth of a ton.

STEP 7 "Type of generation" refers to the renewable energy technology you employ. Use the terms listed at 40 CFR part 73, Appendix A, if such terms are appropriate. Eligible types of generation are: biomass (*i.e.*, combustible energy-producing materials from biological sources, which include wood, plant residues, biological wastes, landfill gas, energy crops and eligible components of municipal solid waste), solar, geothermal and wind resources. You may list a type of renewable energy generation not appearing in Appendix A, provided it meets the requirements of 40 CFR 73.81(c). List such measures using an appropriate term.

At "Plant Name," identify the plant at which the renewable energy generation took place. Use the plant name from NADB or other appropriate name.

"Generation year" refers to the year for which you are claiming renewable energy generation. For instance, if in 1997 you are applying for credit based upon generation achieved in 1995, then the generation year is 1995. You may claim multiple years of generation, but should list each year separately. **You must have initiated the generation on or after January 1, 1992 to receive credit.**

Total the renewable energy generation from each qualified method, including those listed on additional pages, in the "Total" box provided on the right hand side of the form.

For hybrid renewable energy systems, the amount of generation is the MWh that can be attributed to the qualified renewable energy measure. Include documentation showing the hybrid system's total generation, the heat input and heat rate attributed to the non-renewable portion of the generation, and the calculations you used to determine the amount of qualified renewable energy generation.

Step 8 Include copies of pertinent plant operation records that substantiate the amount of renewable energy generation claimed.

Step 9 This step converts the megawatt hours of renewable energy generation to the tons of sulfur dioxide emissions avoided, as follows:

$$\text{Tons of } SO_2 \text{ Avoided} = \frac{\text{Step 7 Total (MWh) x 4 (lbs/MWh)}}{\text{2000 (lbs/ton)}} = \text{Step 7 Total (MWh) X .002} \left(\frac{\text{tons}}{\text{MWh}}\right)$$

Round to the nearest tenth of a ton.

STEP 10 This step sums the tons of sulfur dioxide emissions avoided from qualified conservation methods and renewable energy generation. One allowance will be allocated for each ton of sulfur dioxide emissions avoided due to these practices within the period of applicability (January 1, 1992, to the date on which any unit owned or operated by the applicant becomes a Phase I or Phase II unit.) Allowances will not be allocated for savings to be accrued in future years.

STEP 11 You must identify the allowance tracking account(s) to which the allowances from Step 10 are to be distributed. Allowances may be distributed to one central account or to the accounts of individual units. The subsequent transfer of Reserve allowances follows the same procedures as other allowances, as specified in 40 CFR Part 73.

For approved applications, allowances from the Reserve will be transferred into the applicant's allowance tracking system account(s) beginning in 1995, provided that a sufficient number of allowances remain in the Reserve. If less than a sufficient number of allowances remain, the allowances will be proportionally distributed to the accounts.

STEP 12 The entity with ratemaking authority for the utility must review the application. As the Step 12 certification states, the ratemaking entity for the utility must be able to certify that the least-cost plan or least-cost planning process meets the following requirements of 40 CFR 73.82(a)(4)-(7):

- Provides an opportunity for public notice and comment.
- Evaluates the full range of existing and incremental resources in order to meet expected future demand at lowest system cost.
- Treats demand-side resources and supply-side resources on a consistent and integrated basis.
- Takes into account necessary features for system operation such as diversity, reliability, dispatchability, and other factors of risk.
- Is being implemented by the applicant to the maximum extent practicable.
- Is consistent with the energy conservation measures adopted and the renewable energy generated.

Further, the applicant must demonstrate that the qualified energy conservation measures adopted and qualified renewable energy generated are consistent with the least-cost plan or least-cost planning process.

The ratemaking entity also must be able to certify that measures not included in Appendix A of Part 73 meet the following requirements of 40 CFR 73.81(a)(2) and (c)(2):

- The measures must be consistent with an applicable least-cost planning process.
- The measures must be implemented pursuant to approval by the utility regulatory authority.
- A qualified conservation measure must be a cost-effective demand-side measure that increases the efficiency of the customer's use of electricity (as measured in accordance 40 CFR 73.82(c)) without increasing the use by the customer of any fuel other than qualified renewable energy, industrial waste heat or industrial waste gases.
- A qualified renewable energy measure must be derived from biomass (i.e., combustible energy-producing materials from biological sources, which include wood, plant residue, biological wastes, landfill gas, energy crops, and eligible components of municipal solid waste), solar, geothermal, or wind resources.

STEP 13 The certifications arise from the regulatory requirements.

Only a utility may qualify for the Reserve (40 CFR 73.82(a)(1)).

If your application includes an energy conservation measure and the utility is investor-owned, you must provide the necessary information to enable the U.S. Secretary of Energy to certify that the State regulatory authority has established rates and charges that ensure net income neutrality (40 CFR 73.82(a)(9)). You must submit this information to the Department of Energy directly and not through EPA.

Consistent with 40 CFR 73.82(a)(3), you must certify that the utility "is paying in whole or in part for one or more qualified energy conservation measures or qualified renewable energy generation (that became operational during the period of applicability) either directly or through payment to another person that purchases the qualified energy conservation measure or qualified renewable energy generation."

Measures that are installed before January 1, 1992, or after one of the utility's units becomes a Phase I or Phase II unit do not qualify for the Reserve bonuses (40 CFR 73.80(b)).

Independent power producers that sell qualified energy generation to another utility must submit documents to indicate the energy was purchased according to the purchasing utility's least cost planning process (40 CFR 73.82(a)(8)).

Enter the name of the individual who will act as the certifying official for the utility.

Submission Instructions

To obtain allowances from the Conservation and Renewable Energy Reserve, you must submit this application to the following address:

U.S. ENVIRONMENTAL PROTECTION AGENCY
ACID RAIN DIVISION, 6204J
ATTN: CONSERVATION AND RENEWABLE ENERGY RESERVE
401 M STREET, SW
WASHINGTON, DC 20460

Paperwork Burden Estimate

The burden on the public for collecting and reporting of information under this request is estimated at 78 hours. Send comments regarding this collection of information, including suggestions for reducing the burden, to: Chief, Information Policy Branch (PM-223), U.S. Environmental Protection Agency, 401 M Street, SW, Washington, D.C. 20460; and to: Paperwork Reduction Project (OMB#2060-0258), Office of Information and Regulatory Affairs, Office of Management and Budget, Washington, D.C. 20503. ***Do not send your forms to these addresses; see submission instructions, above.***

United States
Environmental Protection Agency
Acid Rain Program

OMB No. 2060-0258
Expires 1-31-96

Conservation/Renewables Reserve

For more information, see instructions and refer to 40 CFR 73.80, 73.81 and 73.82

This submission is: ☐ New ☐ Revised

Page ☐ of ☐

STEP 1
Identify the applicant

Utility Name	State(s)

STEP 2
Enter information for the person completing this form

Name	Phone

STEP 3
Identify any affected unit owned or operated by the applicant by plant name from NADB and allowance tracking system account ID#

Plant Name	ATS Account ID#

ENERGY CONSERVATION MEASURES AND VERIFICATION

STEP 4
Mark the appropriate box

Verification of conservation measures performed by

☐ State ☐ U.S. EPA (Attach documentation verifying energy savings)

STEP 5
Enter the requested information for each type of conservation measure employed. Total the savings and round to the nearest MWh. If more space is needed, add pages in the appropriate format

Type of Measure or Program	Savings Year	Number of Installations	Energy Savings (MWh)

TOTAL

STEP 6
Convert total from Step 5 to tons of sulfur dioxide emissions avoided by multiplying Step 5 total by .002 tons/MWh. Round to the nearest tenth of a ton

tons

RENEWABLE ENERGY GENERATION

STEP 7
Enter the requested information for each type of renewable energy generation measure employed. Total the generation and round to the nearest MWh. If more space is needed, add pages in the appropriate format

Type of Generation	Plant Name	Generation Year	Energy Generation (MWh)

TOTAL

STEP 8
Mark box and attach documentation

☐ I have attached documentation to verify the amount of renewable energy generation

STEP 9
Convert the total from Step 7 to tons of sulfur dioxide emissions avoided by multiplying Step 7 total by .002 tons/MWh. Round to the nearest tenth of a ton

tons

Utility Name (from Step 1)

TOTAL RESERVE ALLOWANCES

STEP 10
Add together the Step 6 and Step 9 entries; round result to the nearest ton and convert tons to allowances (1 ton = 1 allowance)

allowances

STEP 11
Identify the allowance tracking account(s) and the number of earned reserve allowances to be allocated to each account. The total must equal the number entered at Step 10

Allowance Tracking System Account Number	Allowances
TOTAL	

CERTIFICATION BY RATEMAKING ENTITY

STEP 12
Submit application to the appropriate ratemaking entity for approval

I certify, as the appropriate representative of the applicant's ratemaking entity, that the applicant's least cost plan or least cost planning process meets the requirements of 40 CFR 73.82(a)(4), (5), (6) and (7), and if the applicant is claiming savings for a conservation or renewable energy measure not listed in Appendix A of 40 CFR Part 73, the measure meets the criteria of 40 CFR 73.81(a)(2) or 40 CFR 73.81(c)(2).

If the ratemaking entity performs verification (Step 4 is marked "State"), I also certify that the verification procedures meet the ratemaking entity's requirements and the information and calculations contained in this form are correct and accurate.

Name of Certifying Official	Phone
Name of Regulatory Body	
Signature	Date

CERTIFICATION BY CERTIFYING OFFICIAL FOR THE UTILITY

STEP 13
Read the certifications and sign and date (see instructions)

I certify that the following requirements have been met:

(1) Applicant is a utility as defined in 40 CFR 72.2.
(2) If the applicant is an investor-owned utility submitting an application based on an energy conservation measure, the Department of Energy has certified the fulfillment of the net income neutrality requirement, or such certification is pending.
(3) Applicant has met requirements for payment of conservation measures in 40 CFR 73.82(a)(3).
(4) The qualified energy conservation or renewable energy generation measures are installed and operational on or after January 1, 1992, and before the date on which any unit owned or operated by the applicant becomes a Phase I or Phase II unit.
(5) If the applicant is an independent power producer and sells qualified renewable energy generation to another utility, the generation was sold pursuant to the purchasing utility's least cost plan. Applicant has submitted supporting documentation.

I certify under penalty of law that I have personally examined, and am familiar with, the statements and information submitted in this document and all its attachments. Based on my inquiry of those individuals with primary responsibility for obtaining the information, I certify that the statements and information are to the best of my knowledge and belief true, accurate, and complete. I am aware that there are significant penalties for submitting false statements and information or omitting required statements and information, including the possibility of fine or imprisonment.

Name of Certifying Official	Title
Signature	Date