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FolderID:

Folder Title:
[Global Climate Change and Emissions Trading Policy] [loose] [2]

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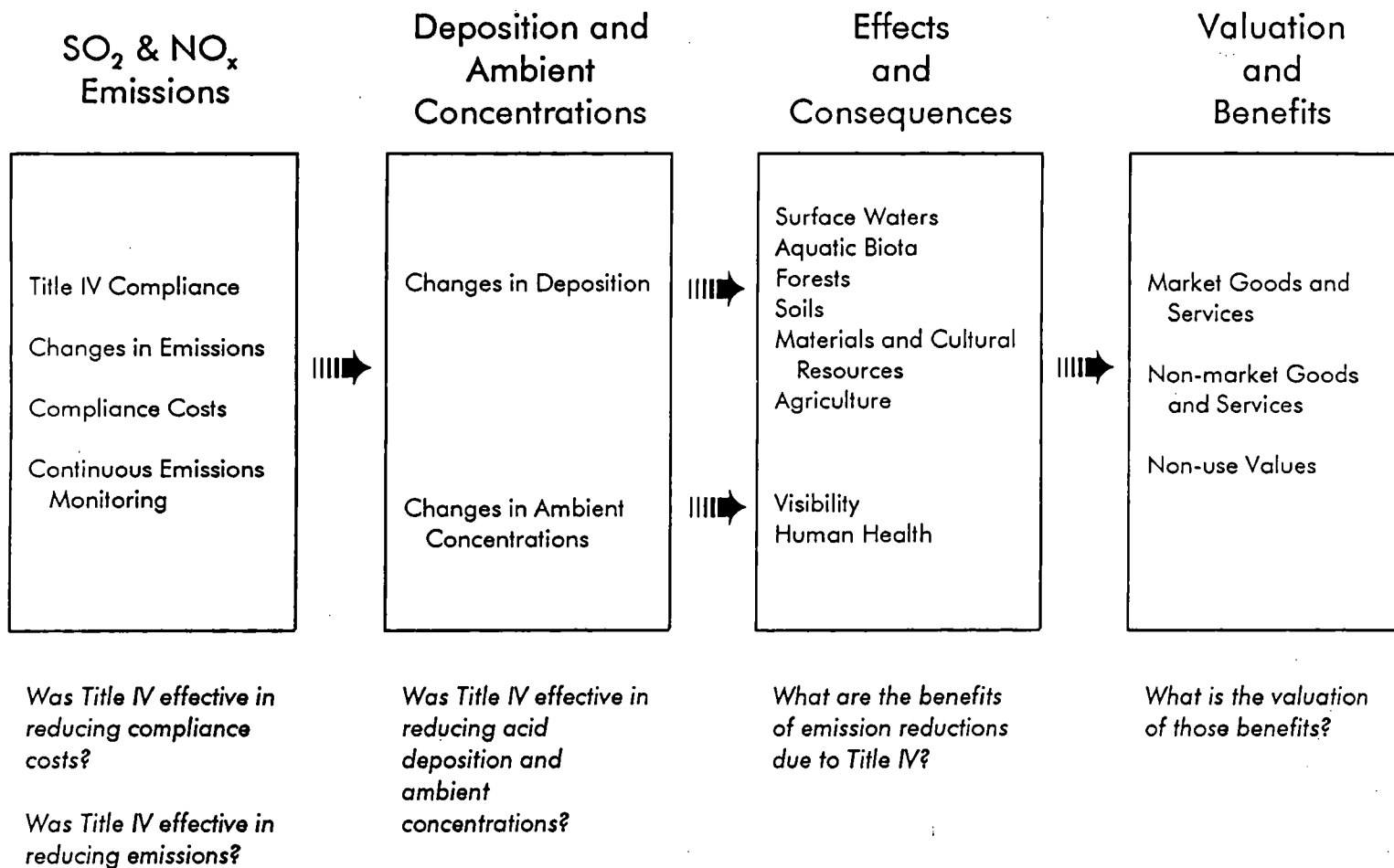


Figure 1. Conceptual framework for NAPAP's integrated assessment.

Allowance Price in dollars

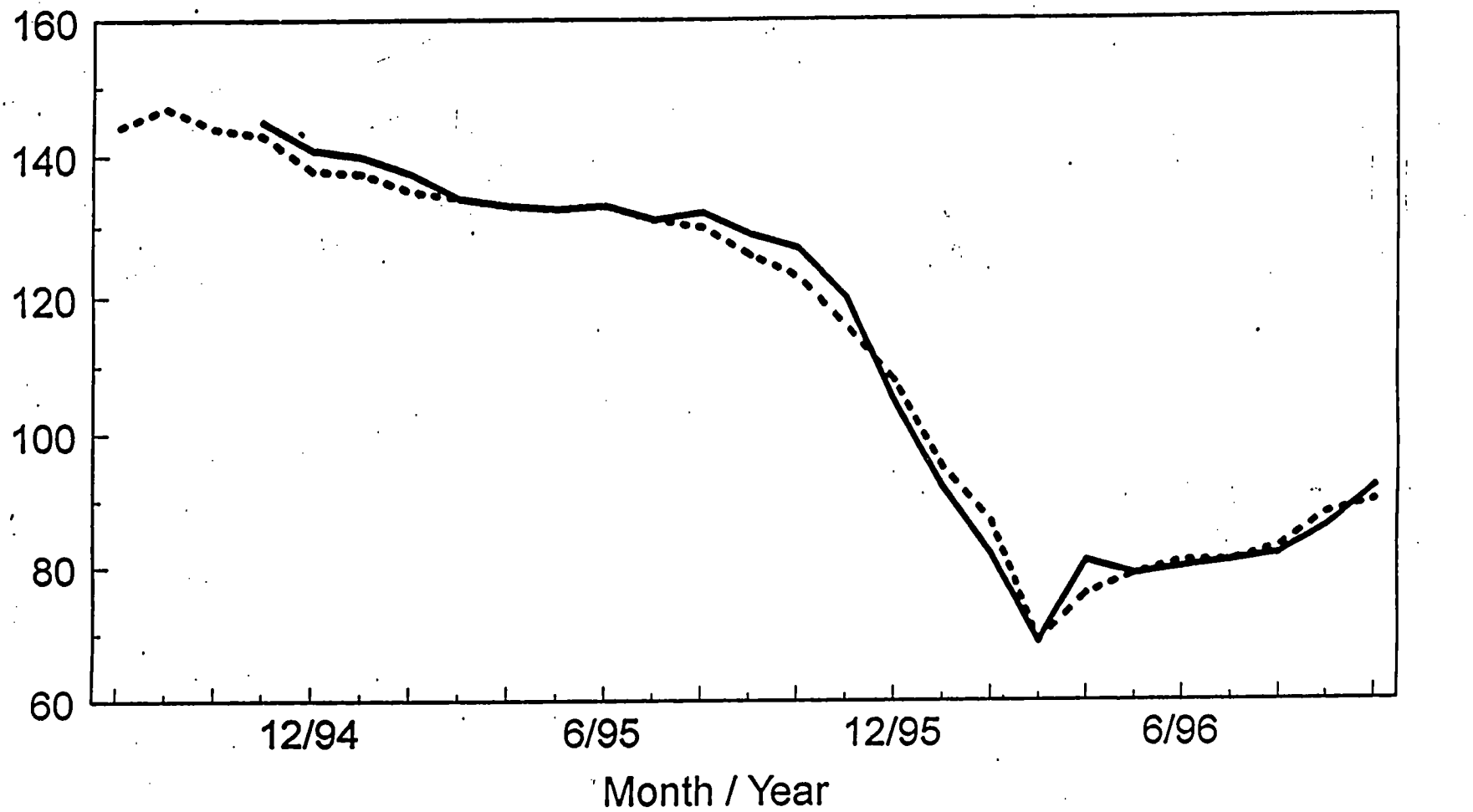


Figure 2. Allowance price trends. *Source: U.S. EPA 1995 Emissions Scorecard*

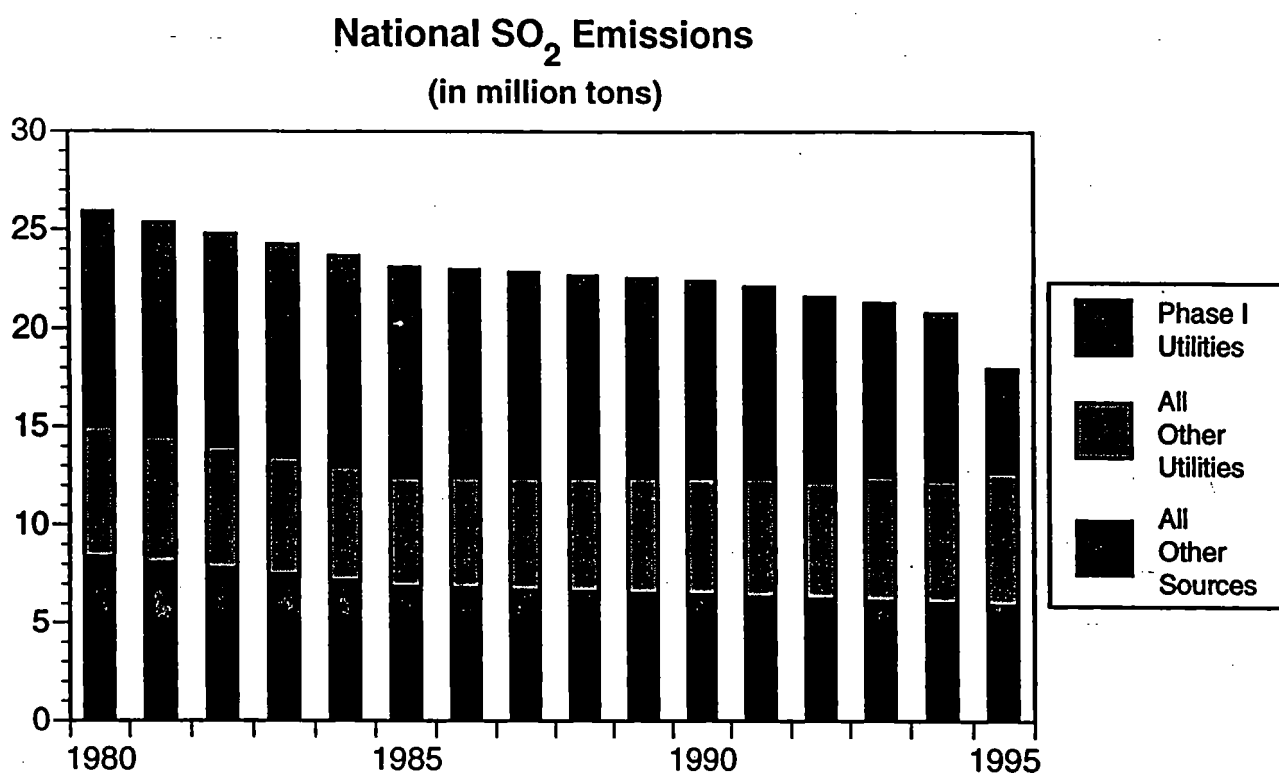


Figure 3. National annual emissions of sulfur dioxide by all sources (1980-1995). Largest emission reductions were from Phase I units in 1995 and a steady decline by all sources through the period. *Source: U.S. EPA, 1996b*

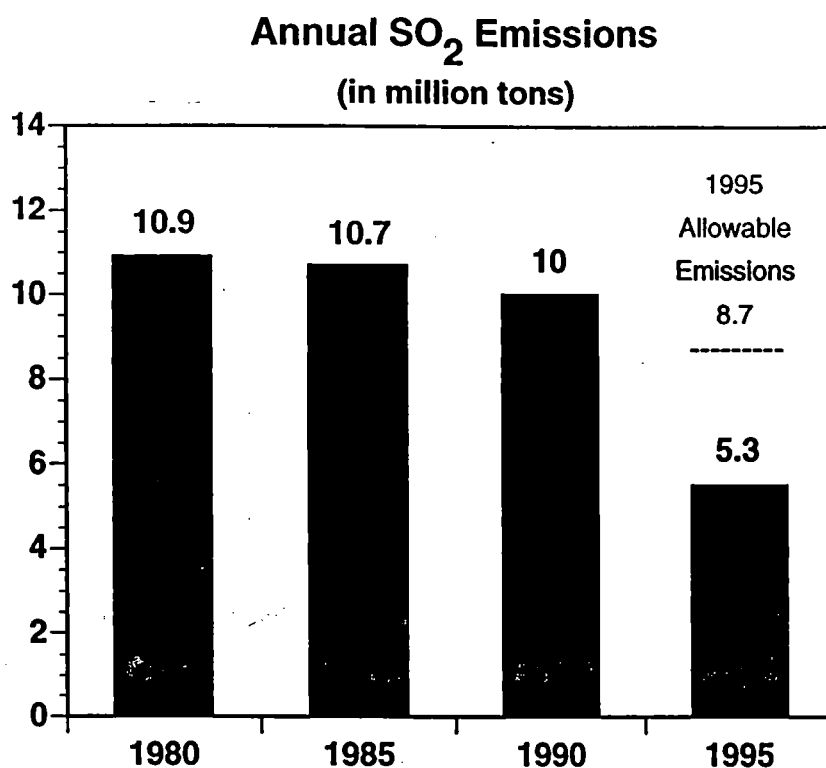


Figure 4. National annual Phase I utility emissions of sulfur dioxide (1980-1995). Total SO₂ emissions by the 445 electric utility units participating in Phase I have been decreasing since 1980, and were 39% below the 8.7 million tons allowed in the first year (1995) of Phase I of Title IV. *Source: U.S. EPA, 1995*

1980-1995 Sulfur Dioxide Emissions

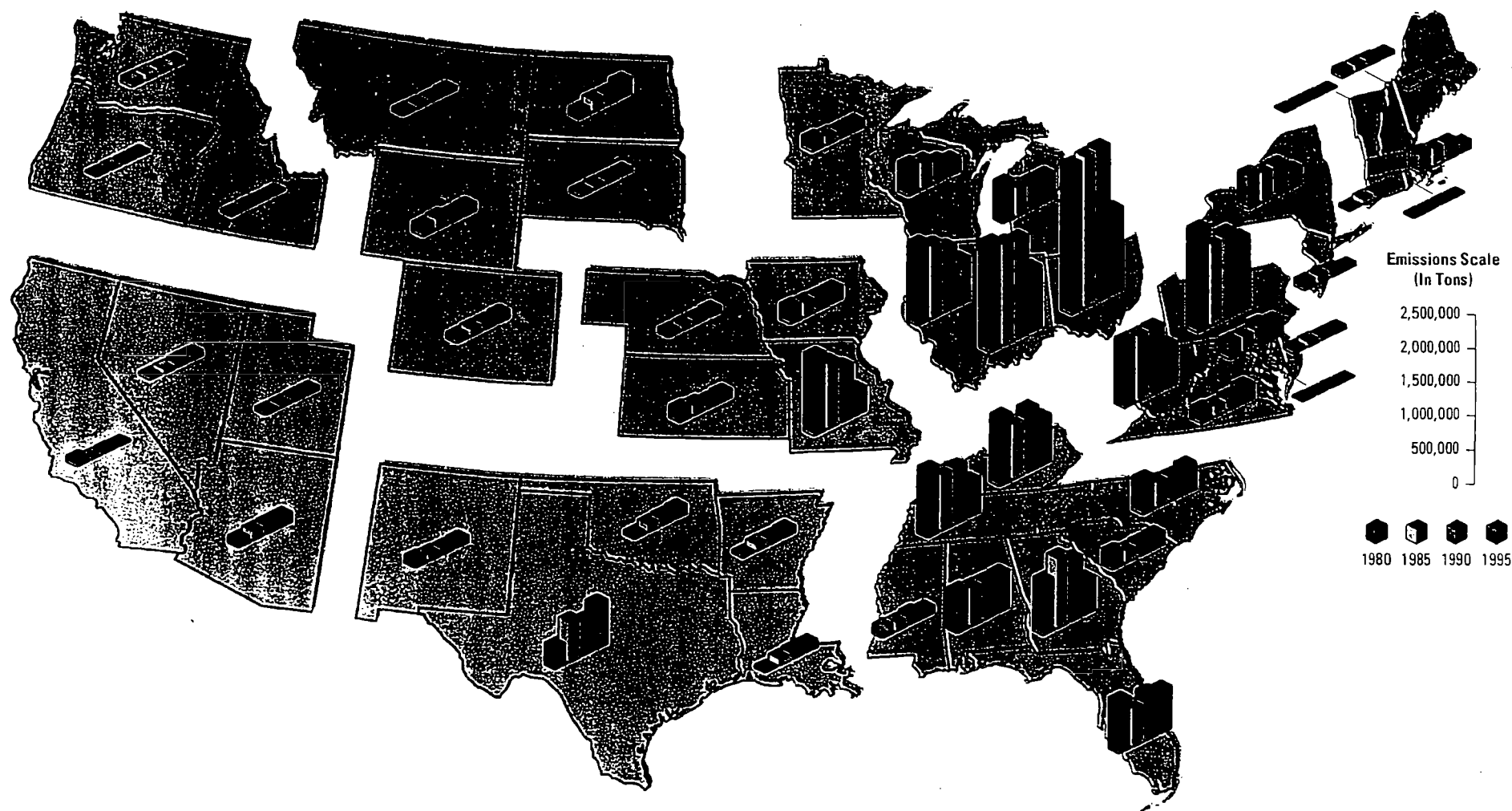


Figure 5. Geographic distribution of annual sulfur dioxide emissions by utilities (1980-1995).
The states are grouped by their respective EPA regions. Source: U.S. EPA, 1997

National NO_x Emissions (in million tons)

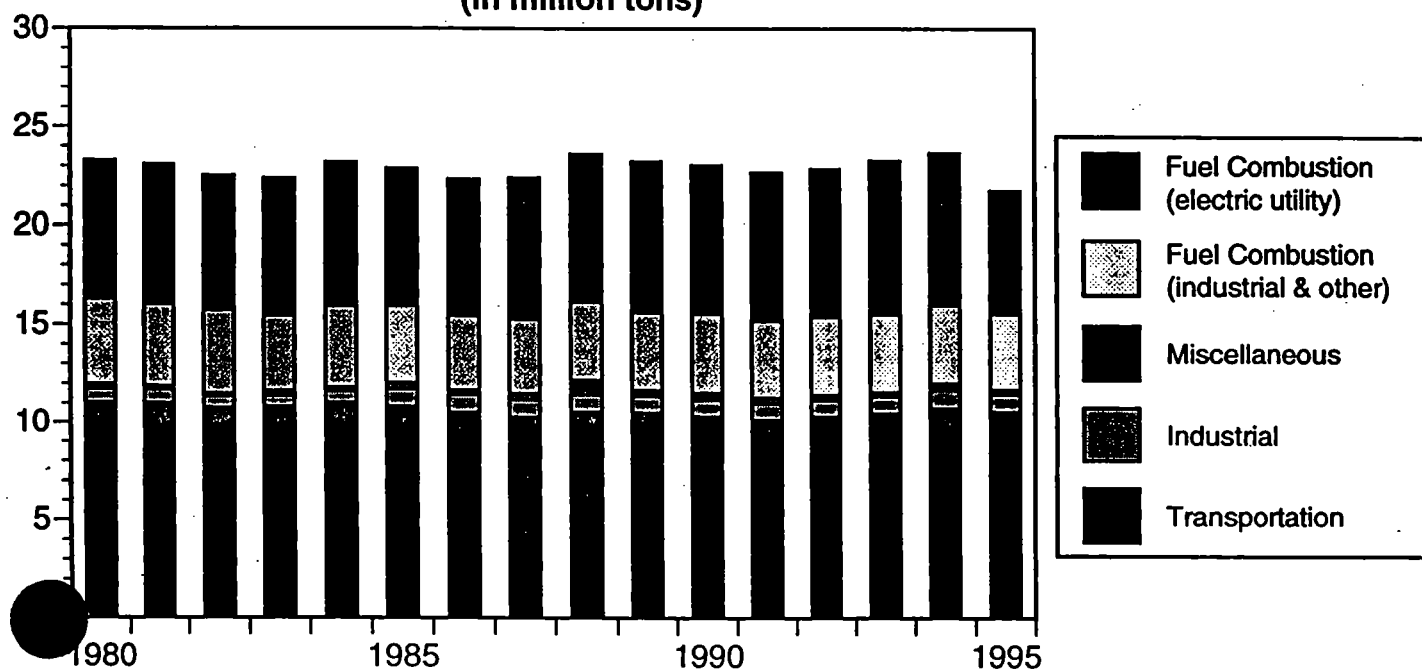


Figure 6. National annual emissions of nitrogen oxides (NO_x) by sources (1980-1995). Total anthropogenic emissions are divided into five categories; both Phase I and Phase II units are included in Fuel Combustion (electric utility). Phase I Title IV requirements for NO_x reductions became effective in 1996. *Source U.S. EPA, 1996b*

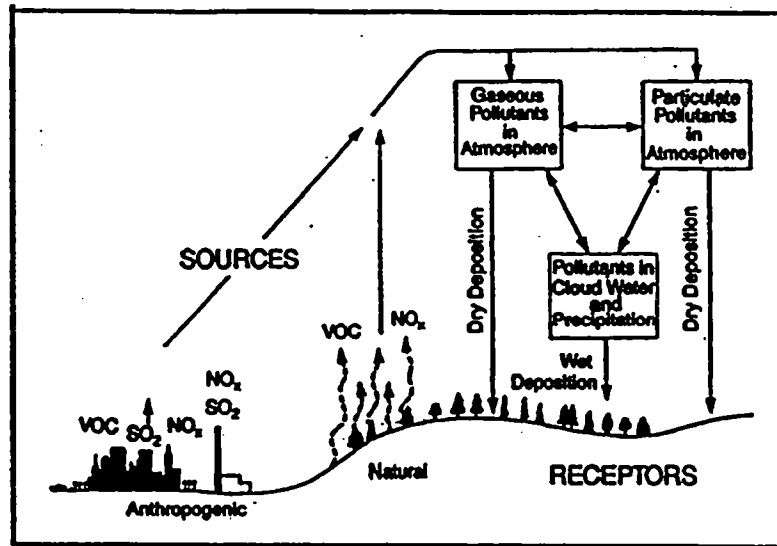


Figure 7. Processes leading to acidic deposition. *Source: Integrated Assessment Report, National Acid Precipitation Assessment Program, 1990*

SO₂ Concentrations, 1986-1995
(annual arithmetic mean)

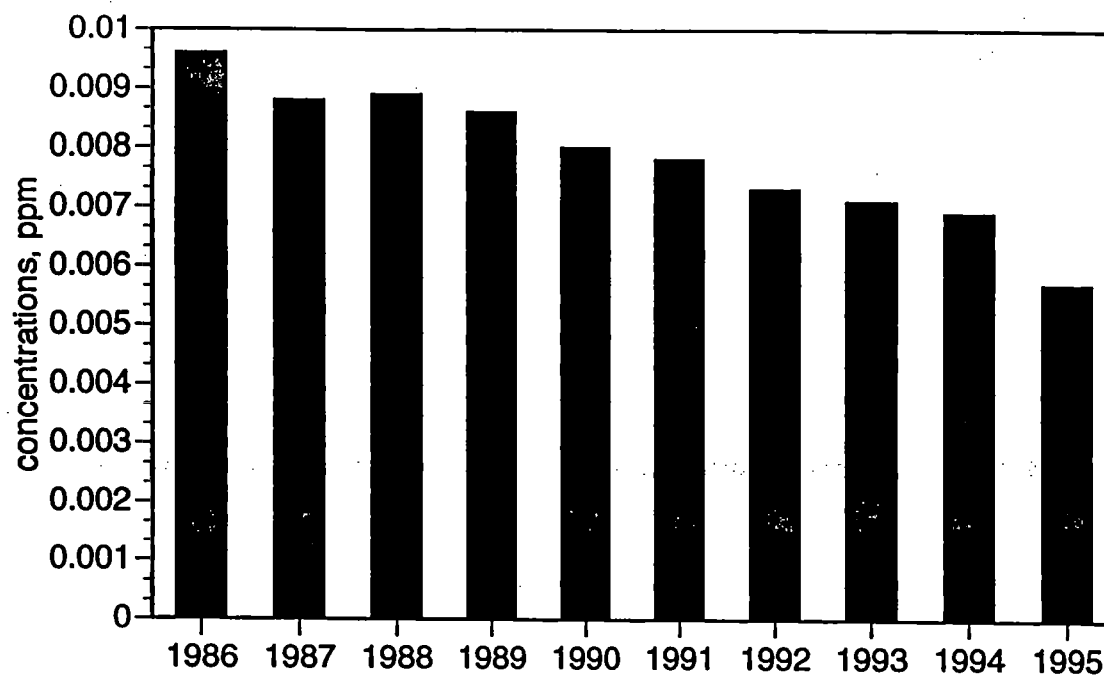


Figure 8. Ambient air concentrations in parts per million (ppm) of sulfur dioxide (SO₂) from 1986-1995. *Source: U.S. EPA, National Air Quality and Emissions Trends Report, 1995.*

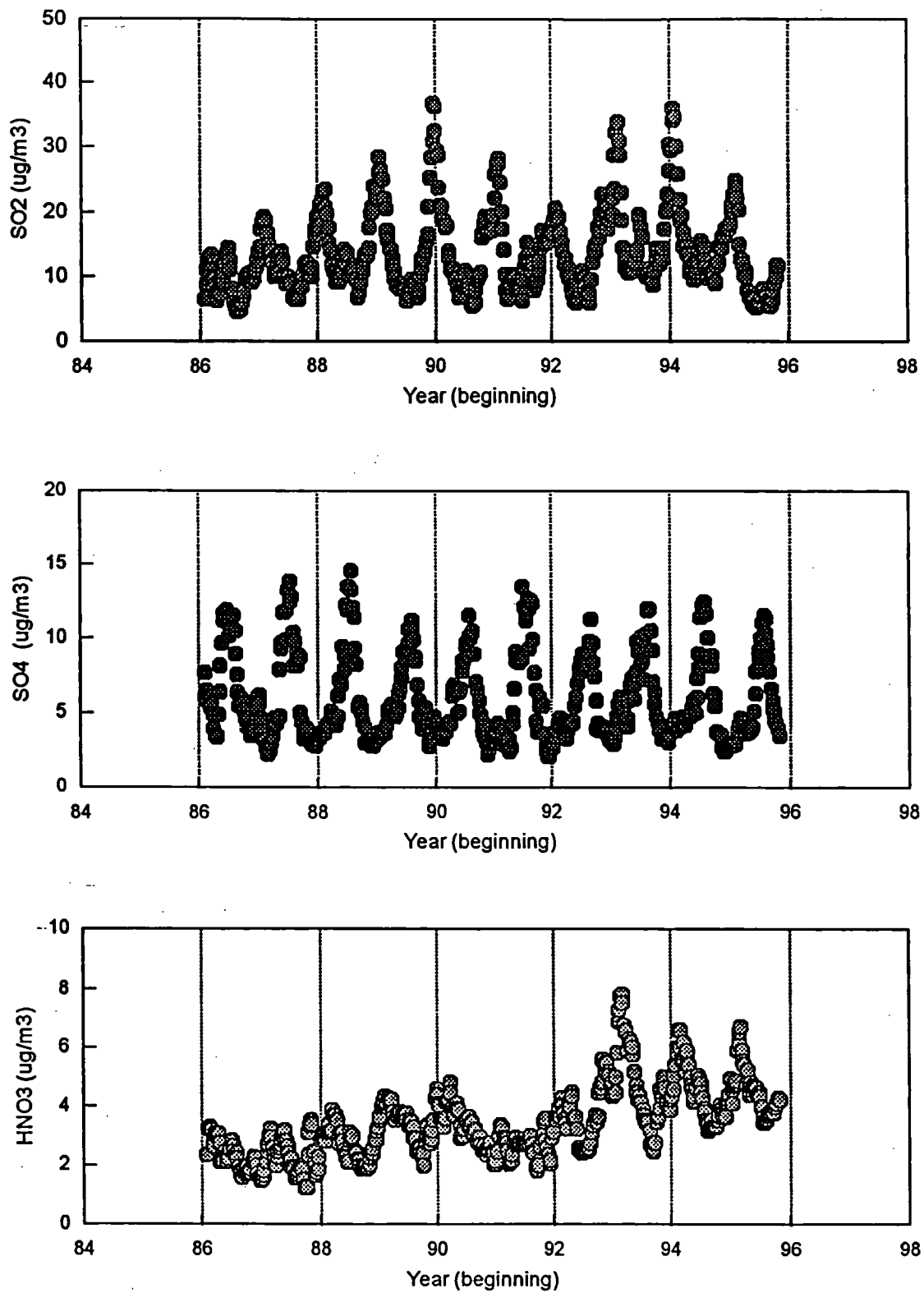


Figure 9. Sulfur dioxide (SO₂), sulfate (SO₄), and nitric acid vapor (HNO₃) concentrations near State College, Pennsylvania. *Source: NOAA Air Resources Laboratory*

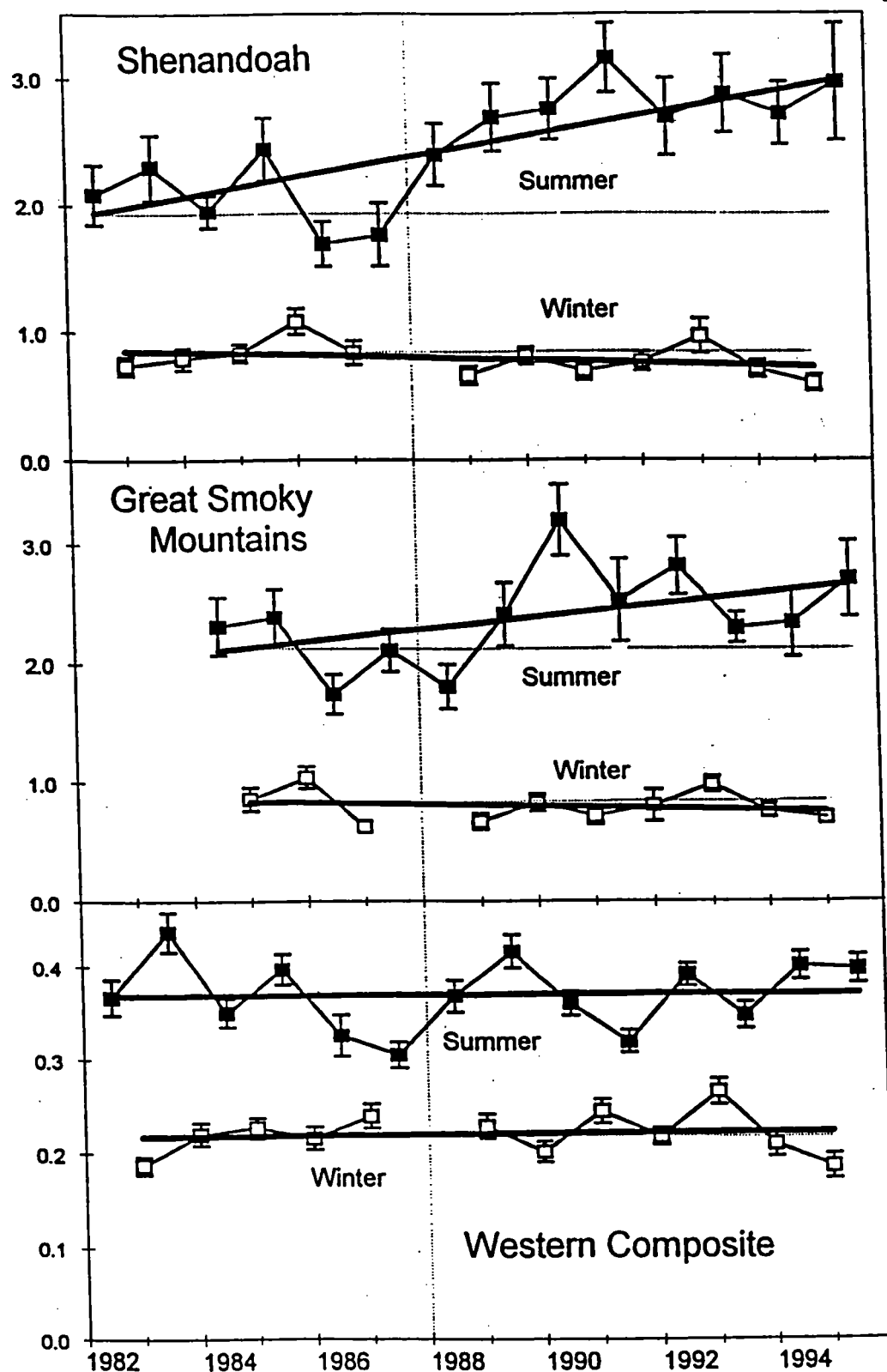


Figure 10. Winter and summer trends in mean concentration ($\mu\text{g}/\text{m}^3$) of fine-particle sulfur. The error bars indicate the standard error of the concentrations. The solid lines indicate the best fits for all points, while the dotted lines indicate the horizontal (no trend). The vertical dotted line indicates the change from stacked filter unit to IMPROVE sampler. *Source: Data from Cahill et al., 1996*

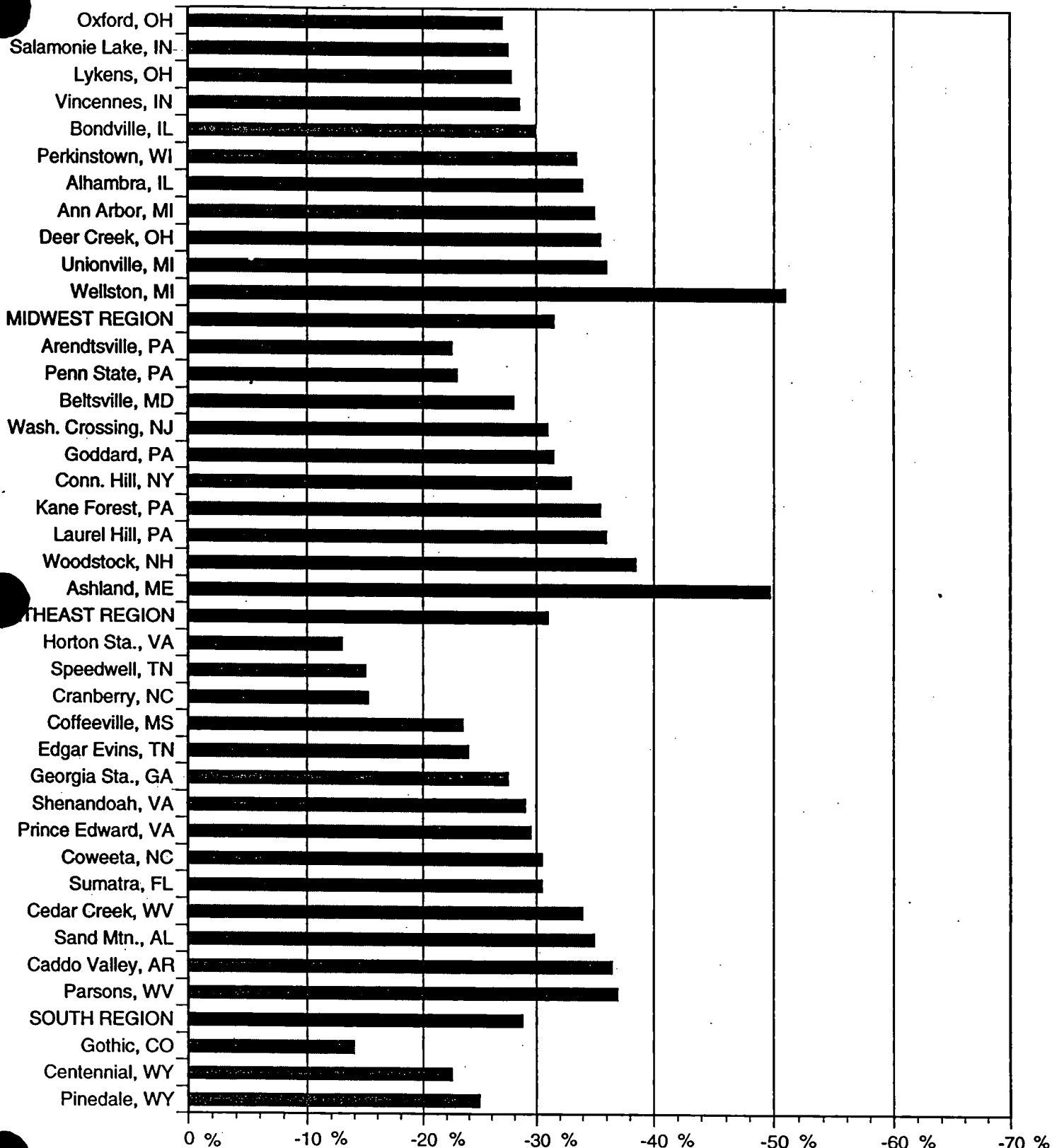


Figure 11. Decreases in ambient air concentrations of total sulfur: 1989-1995. Ambient air concentrations in 1989 and 1995 (based on fiscal year) are based on a model that estimates the yearly trend of ambient air concentrations adjusted for the effects of meteorology and seasonal cycles. *Source: Sickles et al., 1997*

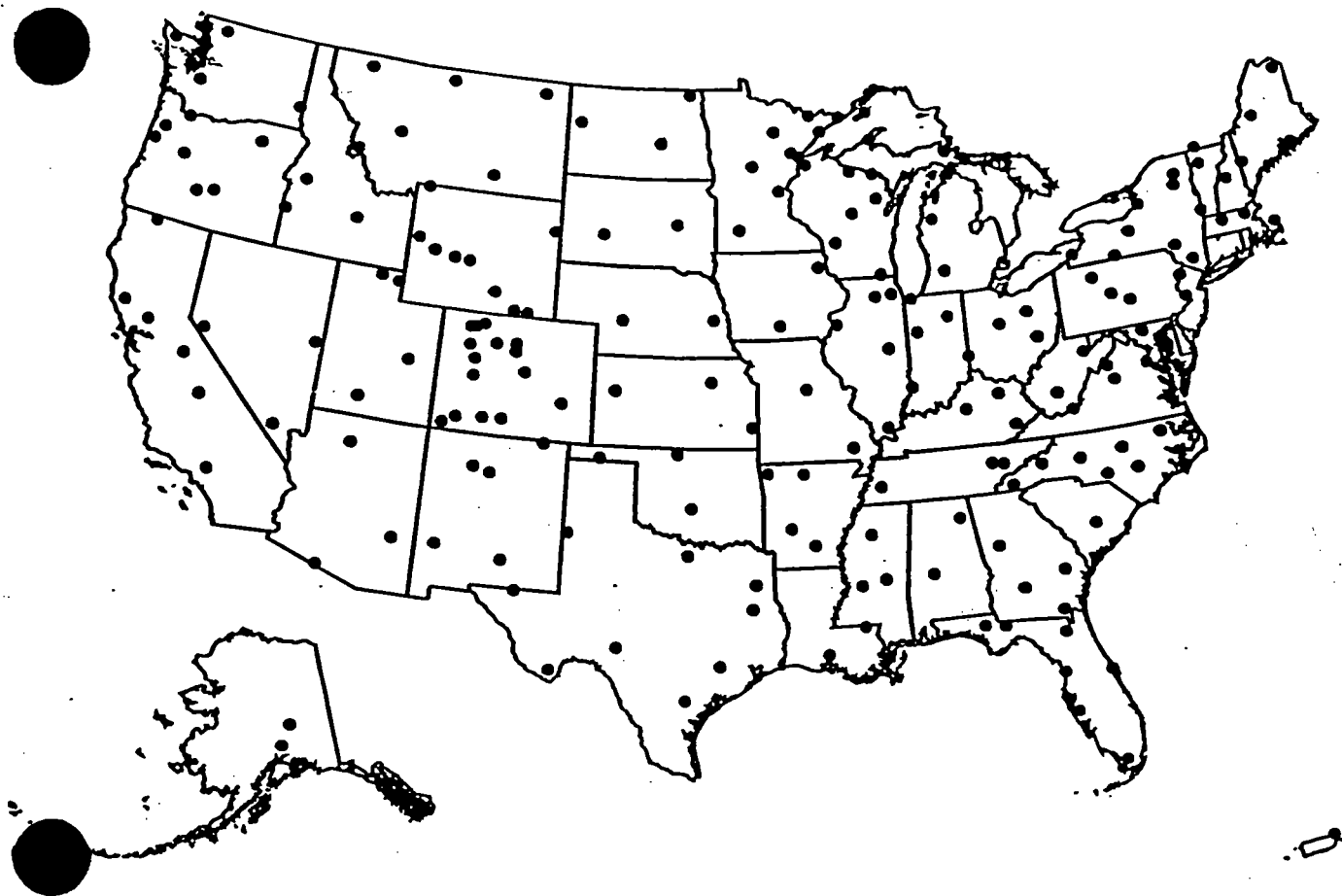
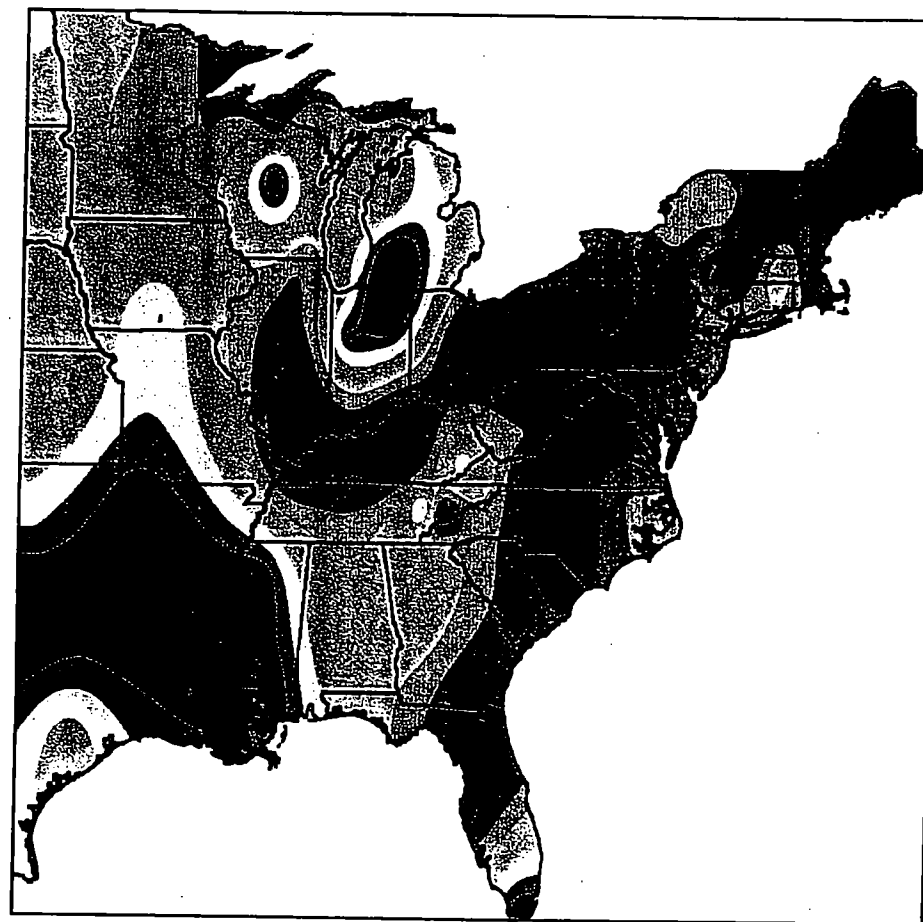


Figure 12. National Atmospheric Deposition Program/National Trends Network (NADP/NTN). The NADP/NTN is the only long-term deposition monitoring network in the United States with national coverage. It is supported by federal, state, and local agencies; universities; and the private sector. *Source: National Atmospheric Deposition Program, 1996*



Percent change in sulfate concentration

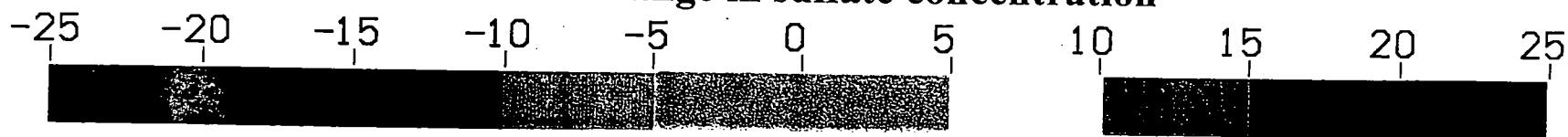


Figure 13. Percent difference between 1995 observed and estimated sulfate concentrations. A seasonal trend model of the observed sulfate concentration in wet deposition data between 1983 and 1994 (before Title IV) was used to estimate sulfate concentrations in 1995. The difference between the 1995 estimate (without Title IV) and 1995 observed concentrations (with Title IV) are the basis for the percentages. Negative values indicate a reduction in sulfate concentrations consistent with Title IV reductions of sulfur dioxide emissions in 1995. *Source: Lynch et al., 1996*



Percent change in nitrate concentration

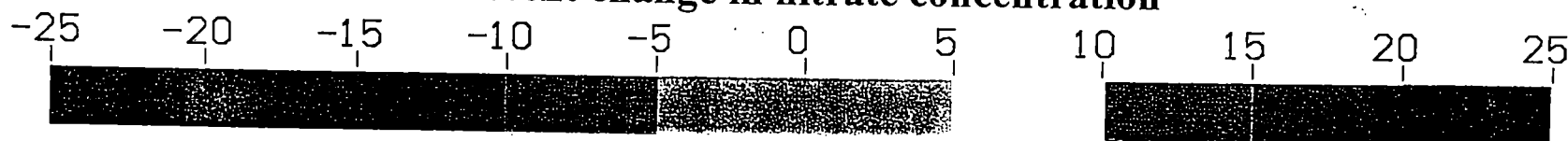
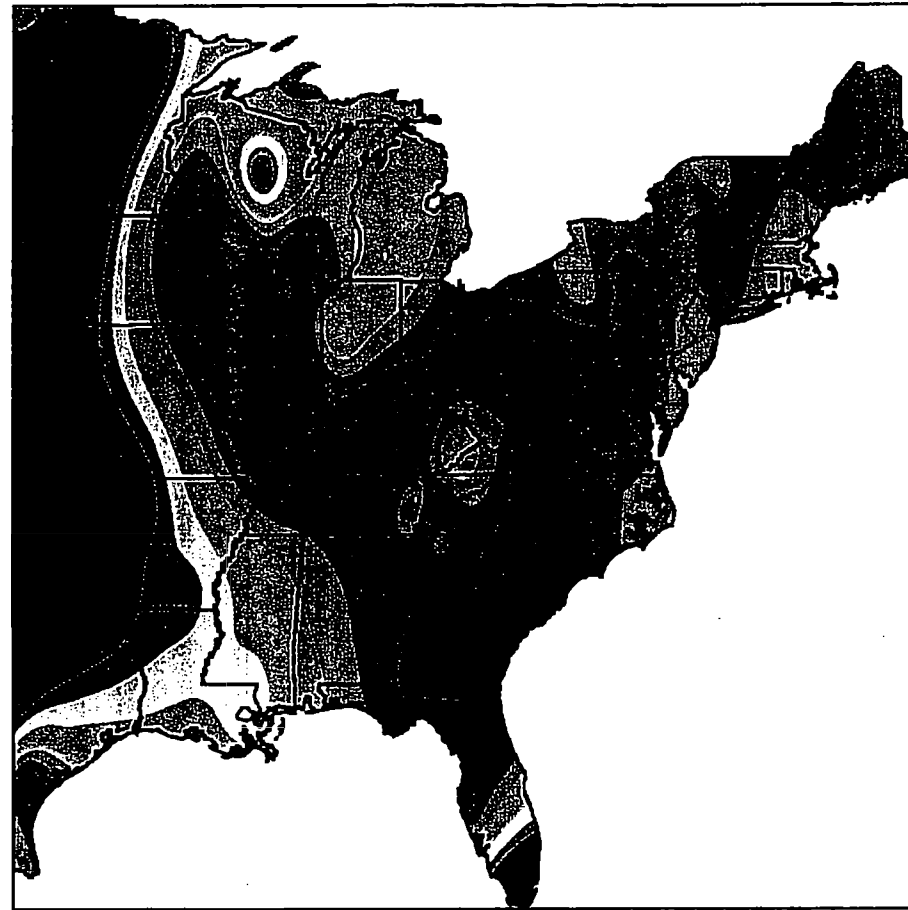


Figure 14. Percent difference between 1995 observed and estimated nitrate concentrations. A seasonal trend model of the observed nitrate concentration in wet deposition data between 1983 and 1994 (before Title IV) was used to estimate nitrate concentrations in 1995. The difference between the 1995 estimate (without Title IV) and 1995 observed concentrations (with Title IV) are the basis for the percentages. Negative values indicate a reduction in nitrate concentrations in 1995. Phase I Title IV requirements for NO_x reductions became effective in 1996. *Source: Lynne et al., 1996*



Percent change in hydrogen ion concentration

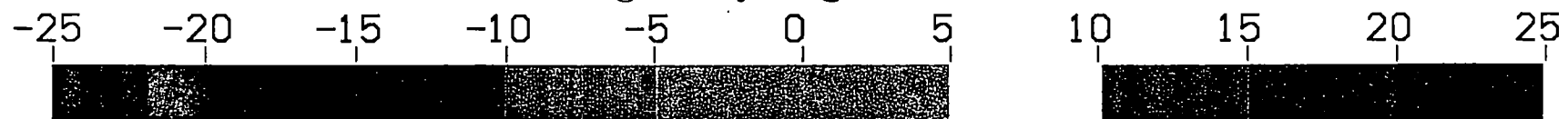


Figure 15. Percent difference between 1995 observed and estimated hydrogen ion concentration (acidity). A seasonal trend model of the observed hydrogen ion concentration in wet deposition data between 1983 and 1994 (before Title IV) was used to estimate hydrogen ion concentrations in 1995. The difference between the 1995 estimate (without Title IV) and 1995 observed concentrations (with Title IV) are the basis for the percentages. Negative values indicate a reduction in hydrogen ion concentration in 1995. *Source: Lynch et al., 1996*

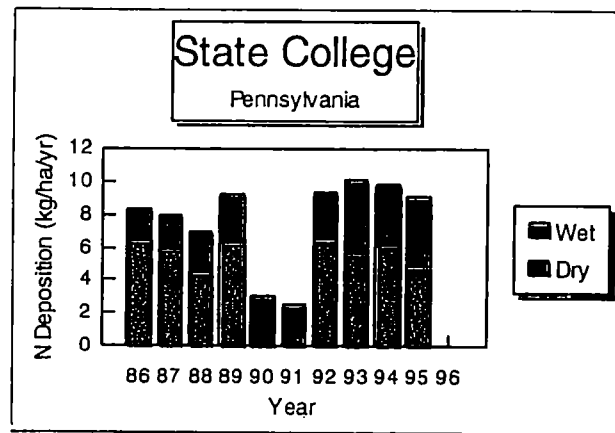
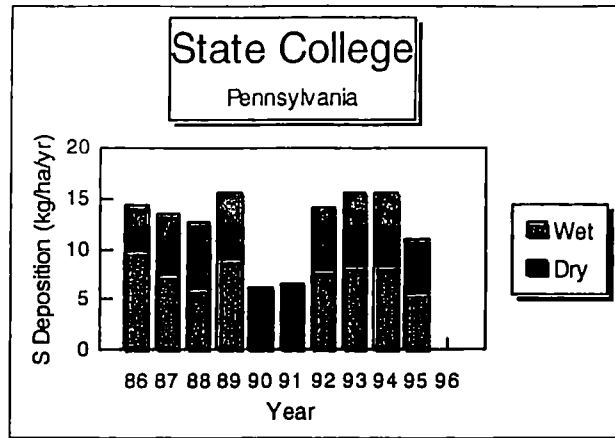


Figure 16. Annual wet and dry deposition of sulfur and nitrogen at State College, PA. *Source: NOAA Air Resources Laboratory*

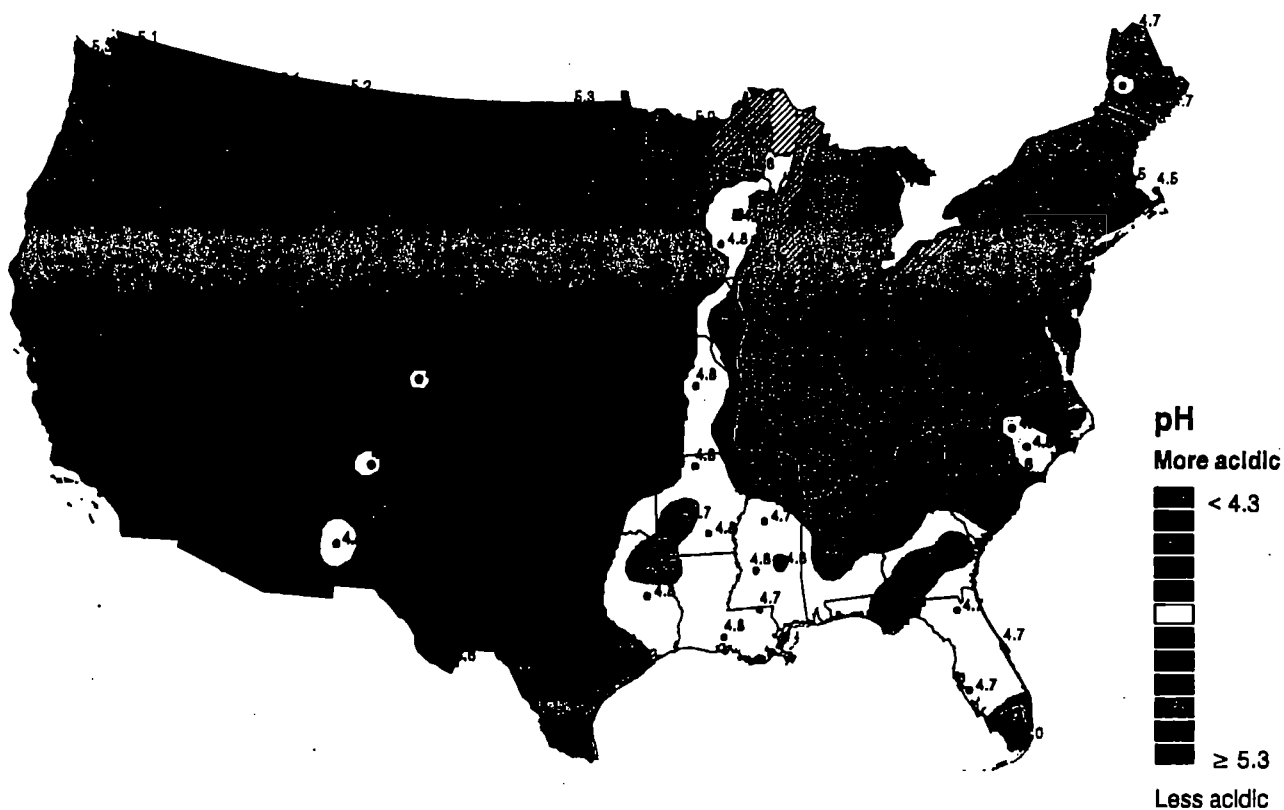


Figure 17. Annual mean hydrogen ion concentrations (in precipitation) as pH for 1995. *Source: National Atmospheric Deposition Program, 1996*

Figure 18. Total wet deposition of sulfate ion in 1995.

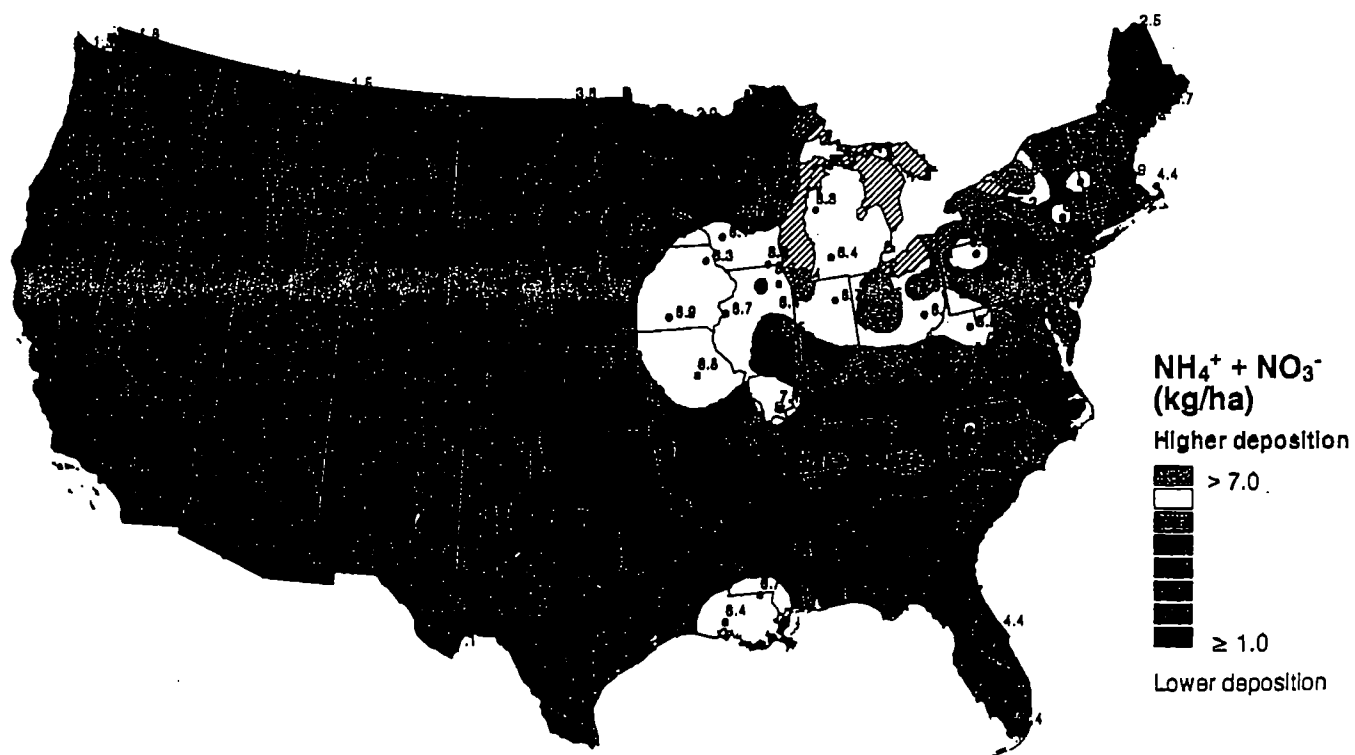
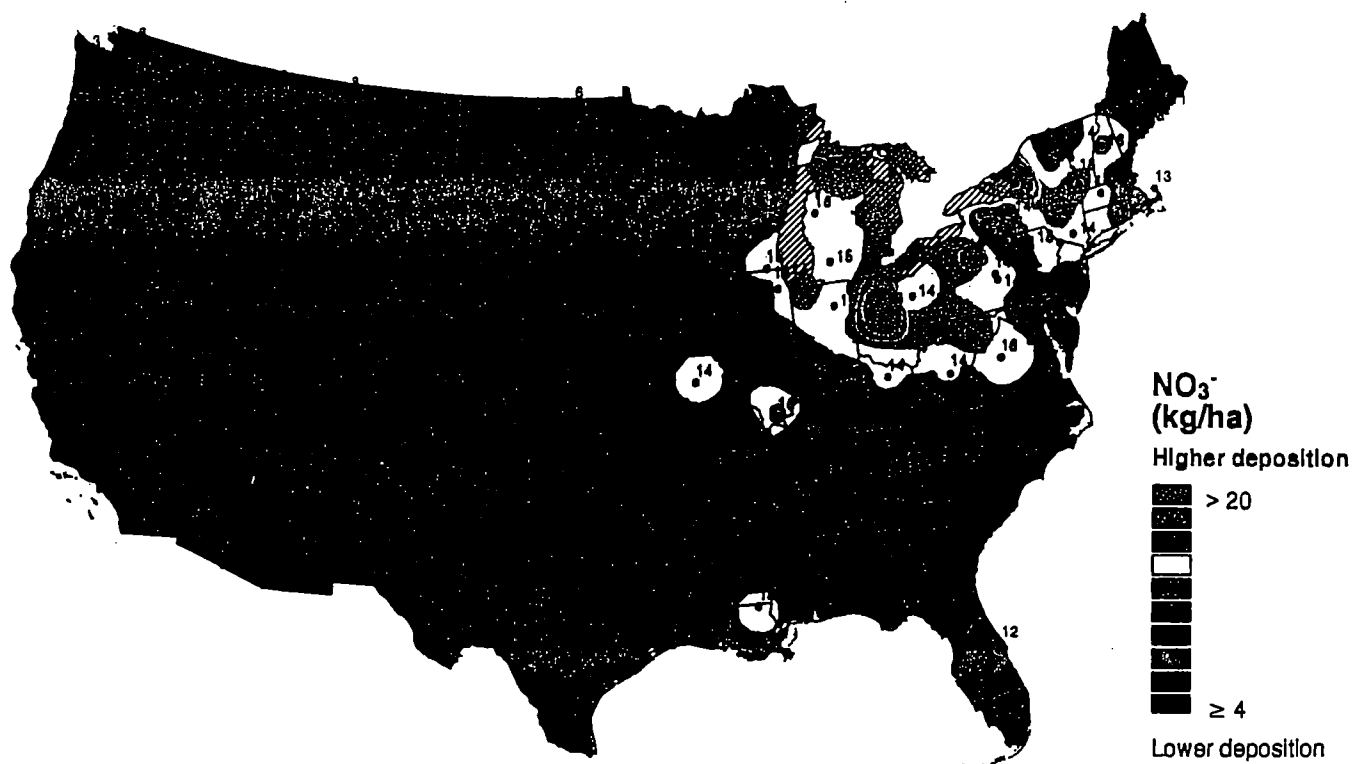


Figure 19. Total wet deposition of nitrate ion in 1995. *Source: National Atmospheric Deposition Program, 1996*

Figure 20. Total wet deposition of nitrogen from nitrate and ammonia in 1995. *Source: National Atmospheric Deposition Program, 1996*

Relative Response Time to Emissions

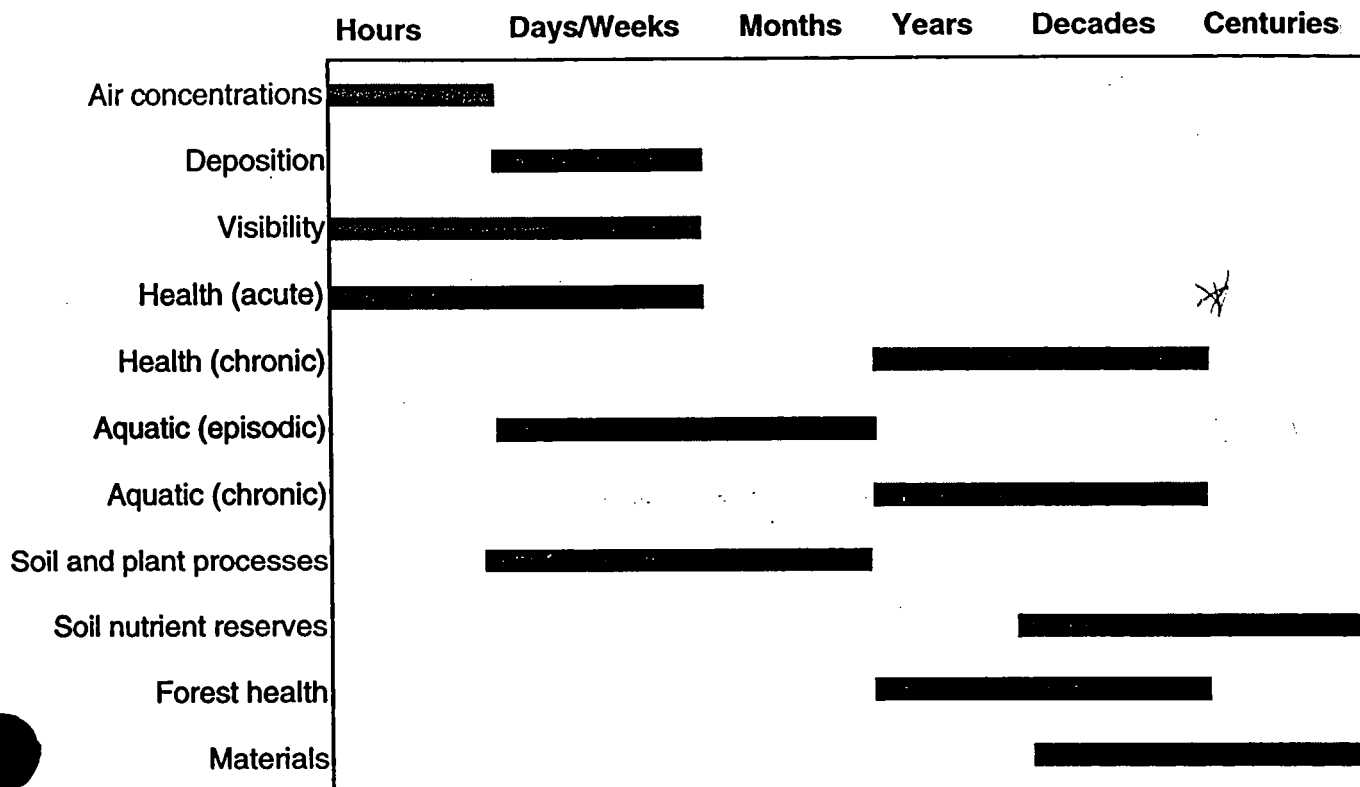


Figure 21. There is a lag between the time a change in emissions of sulfur dioxide and nitrogen oxides from electric utility units increase or decrease and the time when changes in sensitive receptors are detectable. In many effects areas, detectable responses to Title IV emissions reductions are not expected for many years.

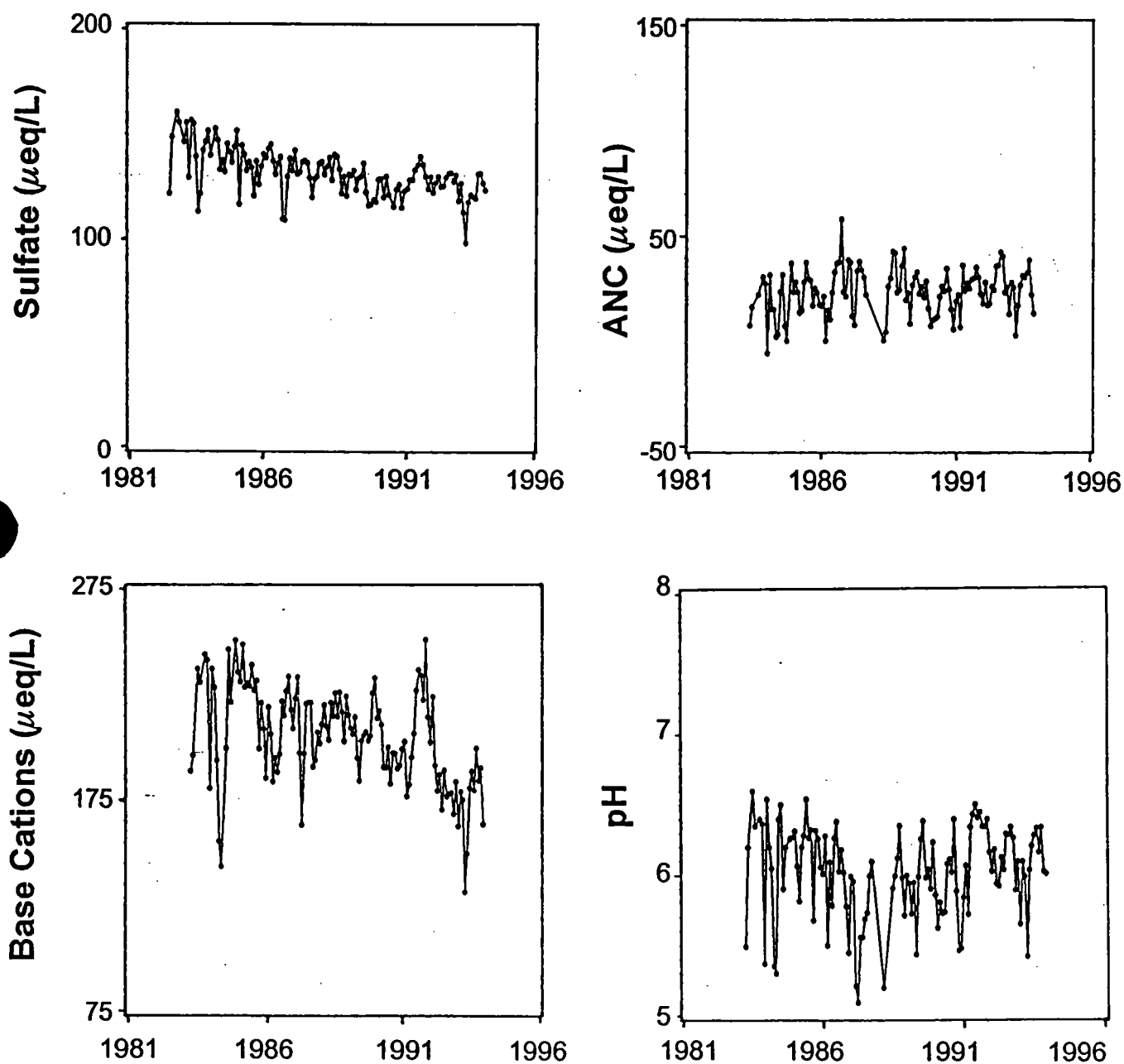


Figure 22. Sulfate, Acid Neutralizing Capacity (ANC), base cations, and pH (acidity) variations in Biscuit Brook, Pennsylvania.

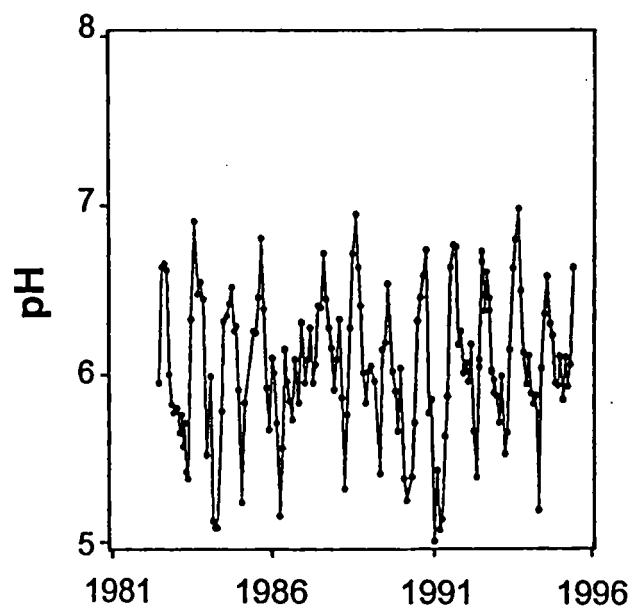
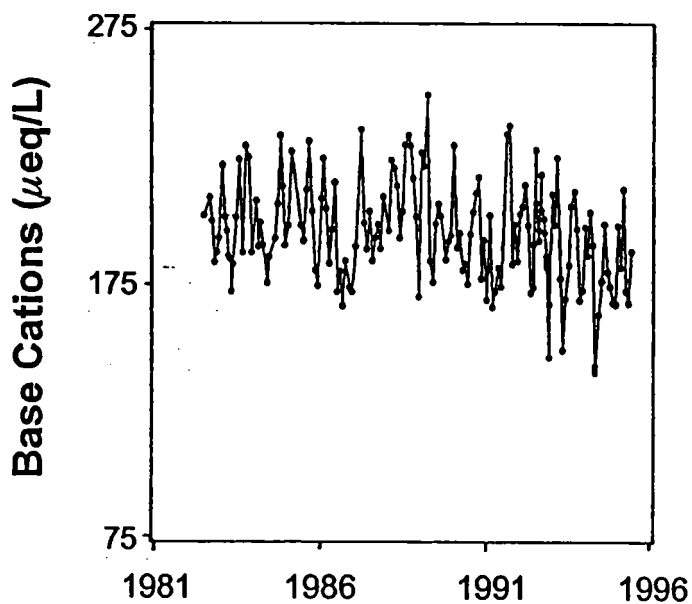
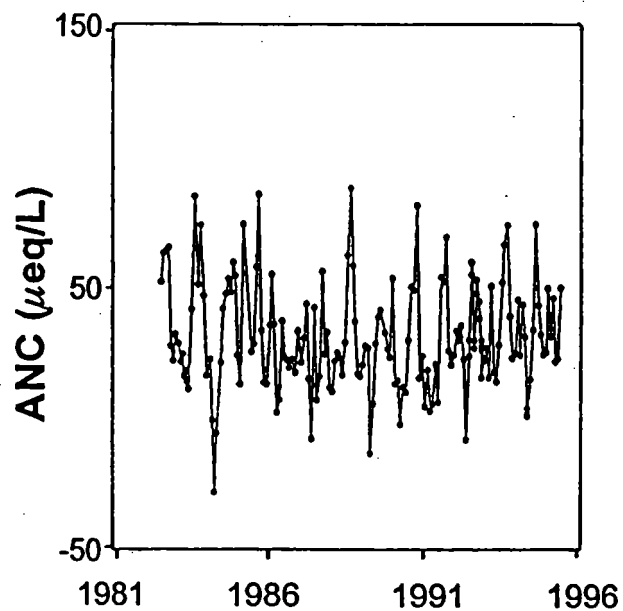
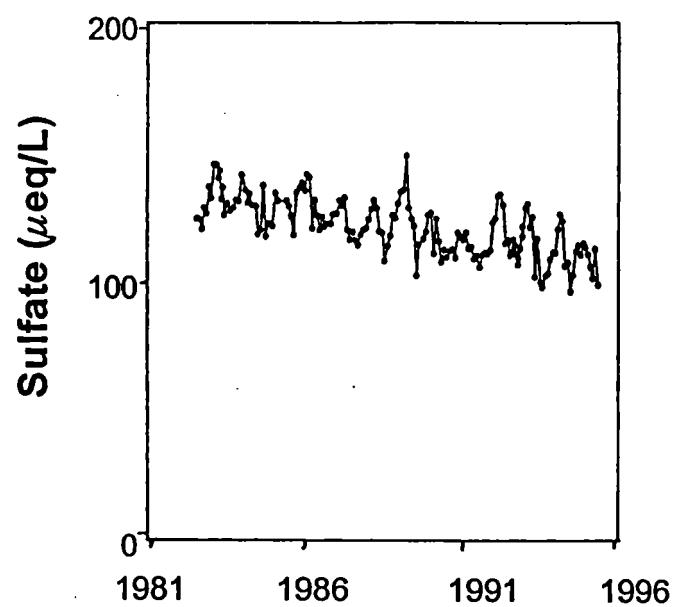


Figure 23. Sulfate, Acid Neutralizing Capacity (ANC), base cations, and pH (acidity) variations in Lake Rondaxe, New York.

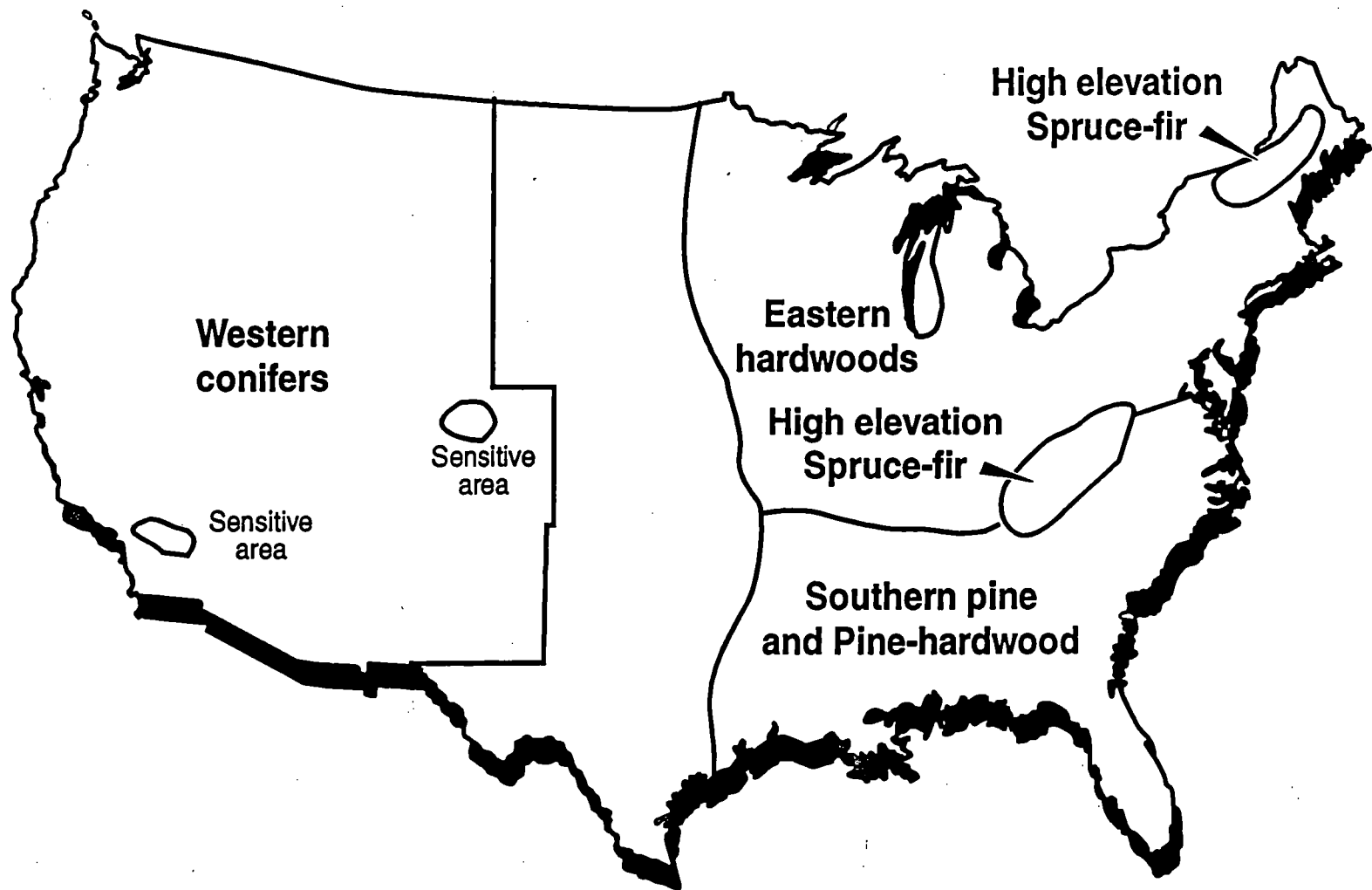


Figure 24. Four broad forest regions were selected for this assessment, based on their general sensitivities and levels of acid deposition.

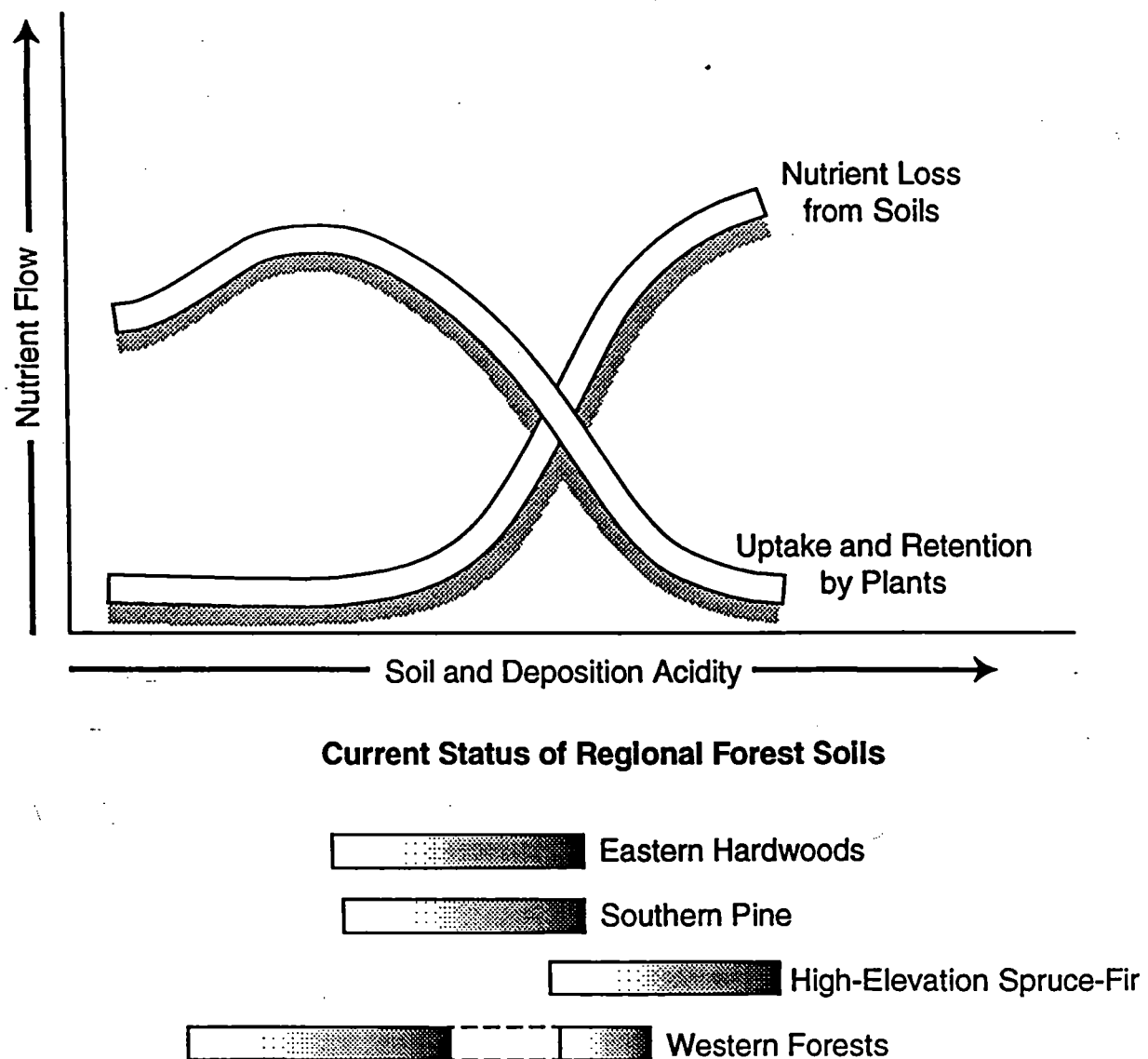


Figure 25. Generalized dose-response relationship for nutrient limitations associated with increasing soil and deposition acidity. As soil and deposition acidity increase, nutrients (e.g., base cations) are leached from the soil and are therefore unavailable for plant growth.

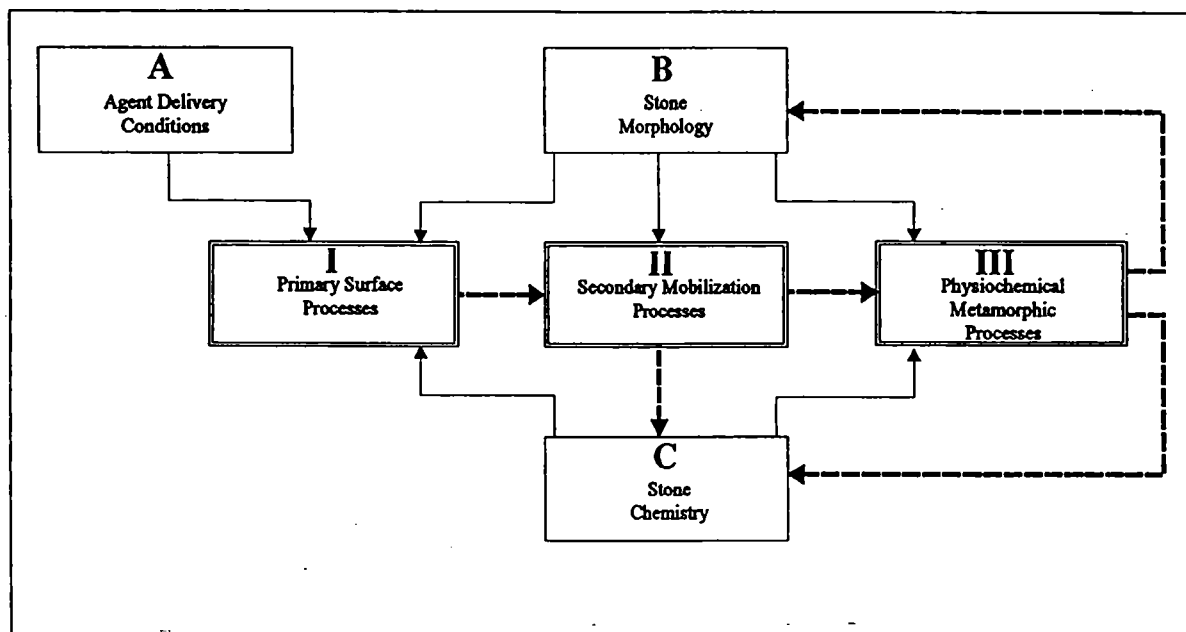


Figure 26. Model of stone alteration processes. The diagram illustrates the linkages between the many processes responsible for the deterioration of stone by acidic deposition. Primary deposition (Panel A) is the way dirt and pollutants are first introduced to the surface of the stone (wet and dry deposition). Panels I, II and III include the different processes that alter the physical or chemical nature of the stone.



Figure 27. Aerosol and visibility monitoring sites. The Interagency Monitoring of Protected Visual Environments (IMPROVE) network is the principal source of aerosol and visibility monitoring information in the United States.

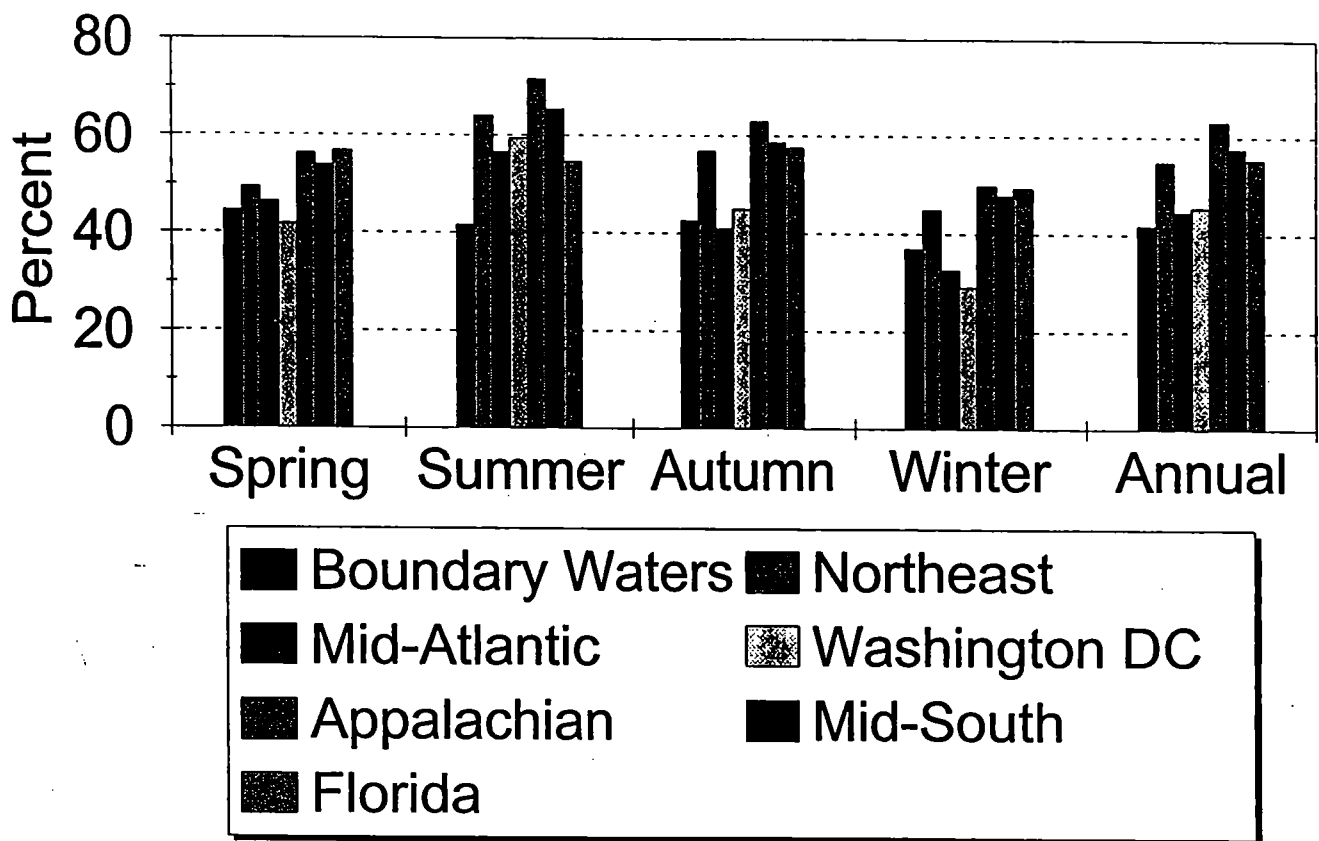


Figure 28. Sulfate contributions to visibility reduction by region. Sulfate aerosol contributions to haze vary by region and season. This figure shows the average seasonal and annual fractional contribution of sulfates to the light extinction (visibility reduction) coefficient. *Source: Isler et al., 1996*

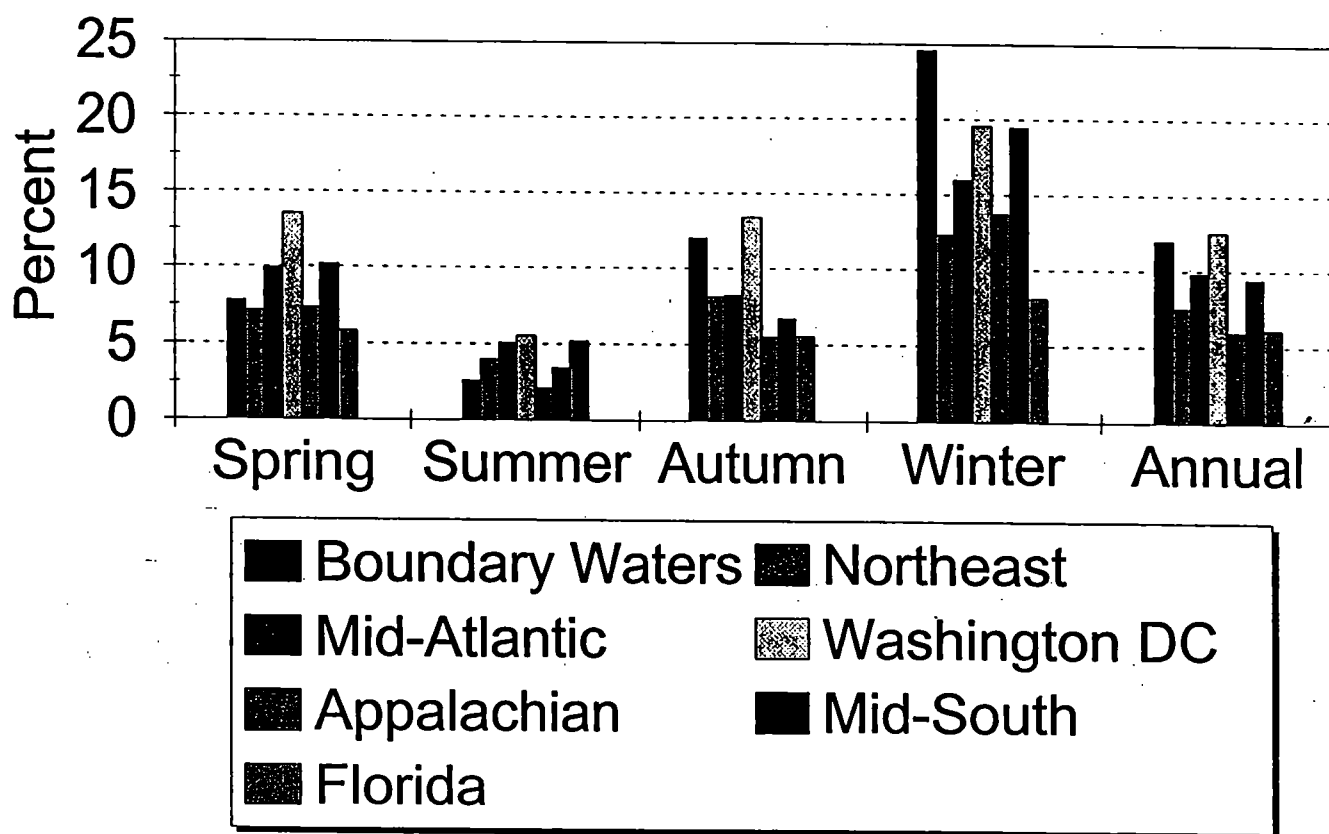


Figure 29. Nitrate contributions to visibility reduction by region. Nitrate aerosol contributions to haze vary by region and season. This figure shows the average seasonal and annual fractional contribution of nitrates to the light extinction (visibility reduction) coefficient. *Source: Sisler et al., 1996*

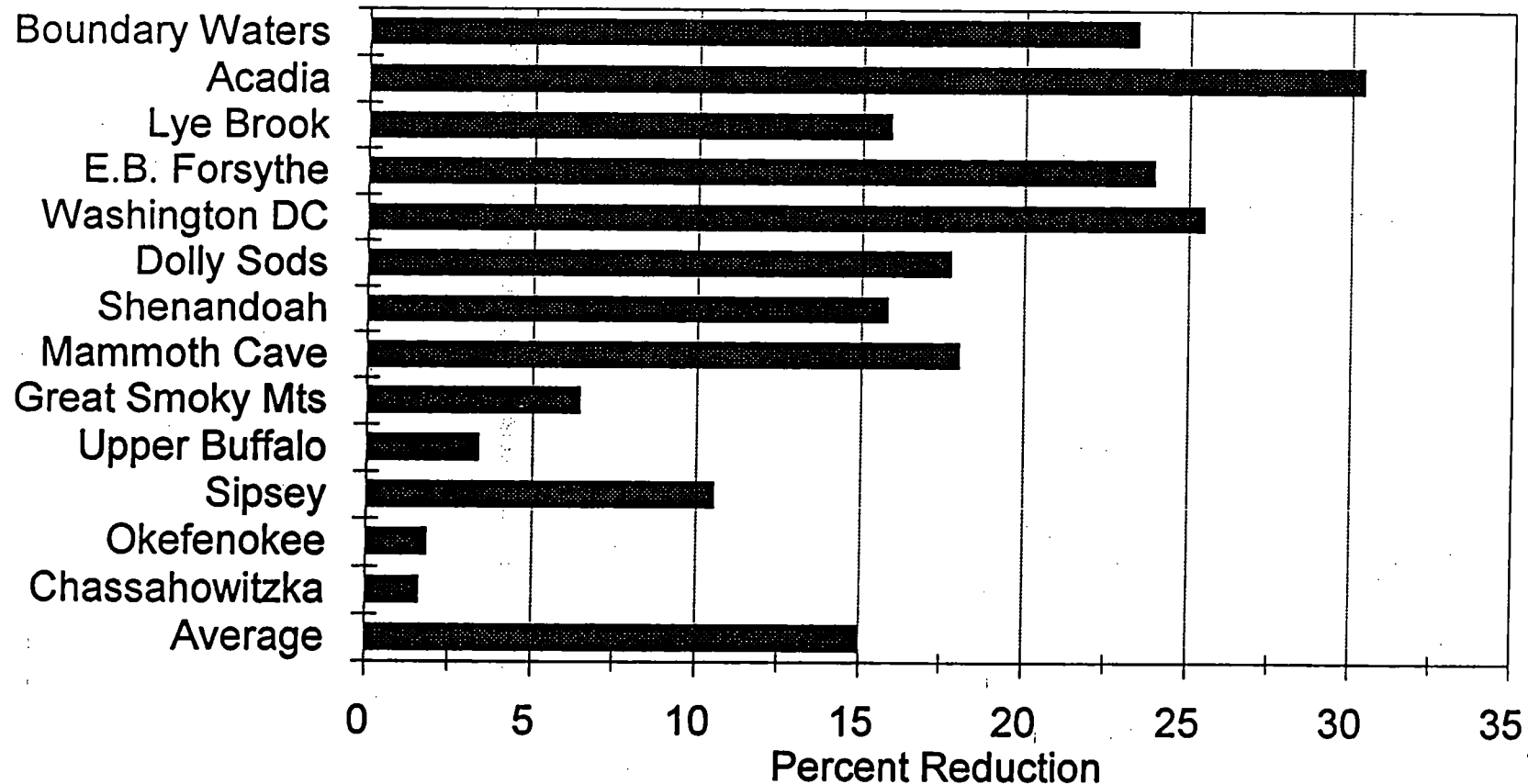


Figure 30. Annual particulate sulfate reduction in 1995 compared to the 1993-1994 mean, by region.

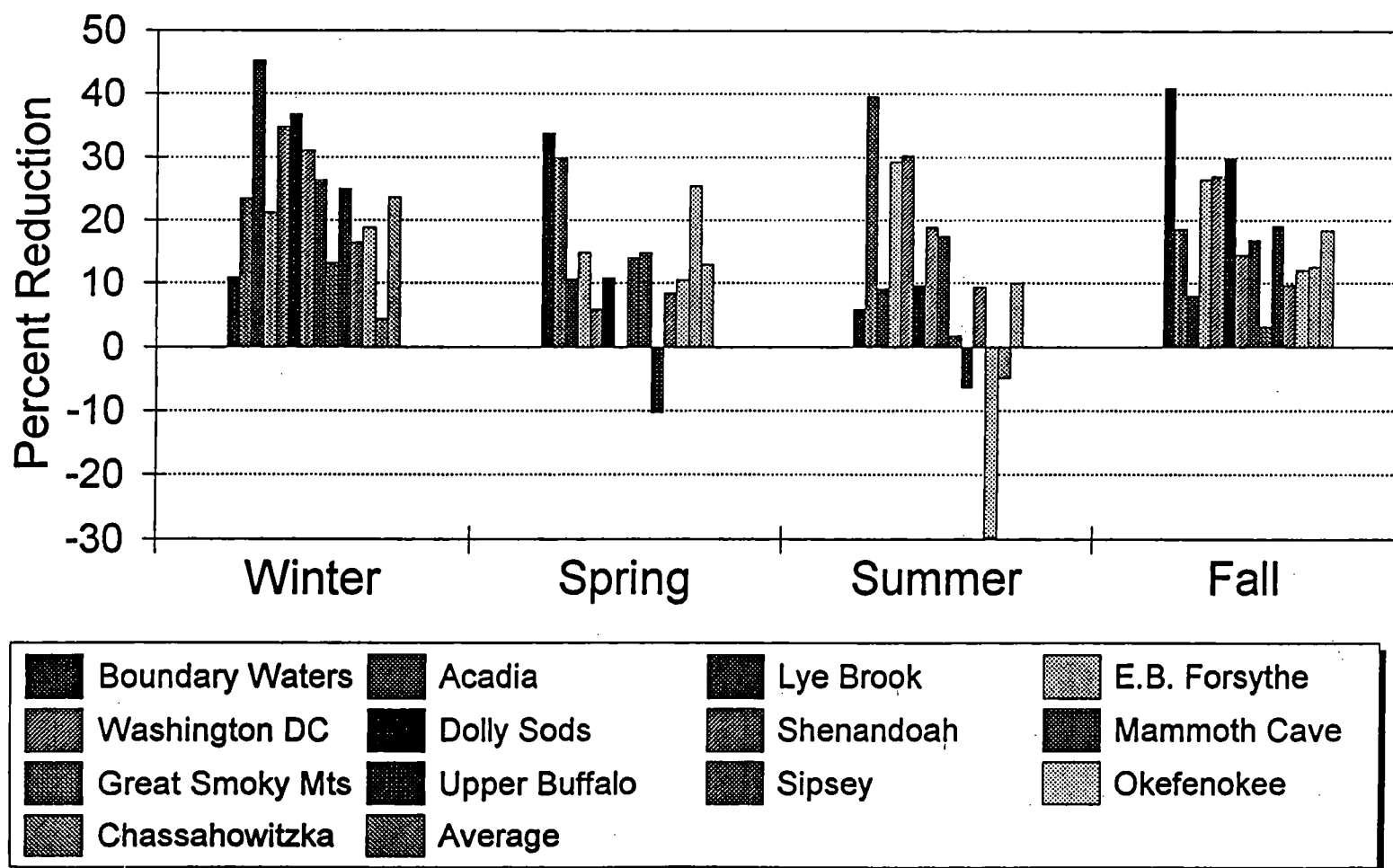


Figure 31. Seasonal particulate sulfate reduction in 1995 compared to the 1993-1994 mean, by region.

Section 401

Findings and Purposes [42 U.S.C. 7651]

(a) Findings.--The Congress finds that--

(1) the presence of acidic compounds and their precursors in the atmosphere and in deposition from the atmosphere represents a threat to natural resources, ecosystems, materials, visibility, and public health;

(2) the principal sources of the acidic compounds and their precursors in the atmosphere are emissions of sulfur and nitrogen oxides from the combustion of fossil fuels;

(3) the problem of acid deposition is of national and international significance;

(4) strategies and technologies for the control of precursors to acid deposition exist now that are economically feasible, and improved methods are expected to become increasingly available over the next decade;

(5) current and future generations of Americans will be adversely affected by delaying measures to remedy the problem;

(6) reduction of total atmospheric loading of sulfur dioxide and nitrogen oxides will enhance protection of the public health and welfare and the environment; and

(7) control measures to reduce precursor emissions from steam-electric generating units should be initiated without delay.

(b) Purposes.--The purpose of this title is to reduce the adverse effects of acid deposition through reductions in annual emissions of sulfur dioxide of ten million tons from 1980 emission levels, and, in combination with other provisions of this Act, of nitrogen oxides emissions of approximately two million tons from 1980 emission levels, in the forty-eight contiguous States and the District of Columbia. It is the intent of this title to effectuate such reductions by requiring compliance by affected sources with prescribed emission limitations by specified deadlines, which limitations may be met through alternative methods of compliance provided by an emission allocation and transfer system. It is also the purpose of this title to encourage energy conservation, use of renewable and clean alternative technologies, and pollution prevention as a long-range strategy, consistent with the provisions of this title, for reducing air pollution and other adverse impacts of energy production and use.

Section 402

Definitions [42 U.S.C. 7651a]

As used in this title:

(1) The term 'affected source' means a source that includes one or more affected units.

(2) The term 'affected unit' means a unit that is subject to emission reduction requirements or limitations under this title.

(3) The term 'allowance' means an authorization, allocated to an affected unit by the Administrator under this title, to emit, during or after a specified calendar year, one ton of sulfur dioxide.

(4) The term 'baseline' means the annual quantity of fossil fuel consumed by an affected unit, measured in millions of British Thermal Units ('mmBtus'), calculated as follows:

(A) For each utility unit that was in commercial operation prior to January 1, 1985, the baseline shall be the annual average quantity of mmBtu's consumed in fuel during calendar years 1985, 1986, and 1987, as recorded by the Department of Energy pursuant to Form 767. For any utility unit for which such form was not filed, the baseline shall be the level specified for such unit in the 1985 National Acid Precipitation Assessment Program (NAPAP) Emissions Inventory, Version 2, National Utility Reference File (NURF) or in a corrected data base as established by the Administrator pursuant to paragraph (3). For non-utility units, the baseline is the NAPAP Emissions Inventory, Version 2. The Administrator, in the Administrator's sole discretion, may exclude periods during which a unit is shutdown for a continuous period of four calendar months or longer, and make appropriate adjustments under this paragraph. Upon petition of the owner or operator of any unit, the Administrator may make appropriate baseline adjustments for accidents that caused prolonged outages.

(B) For any other nonutility unit that is not included in the NAPAP Emissions Inventory, Version 2, or a corrected data base as established by the Administrator pursuant to paragraph (3), the baseline shall be the annual average quantity, in mmBtu consumed in fuel by that unit, as calculated pursuant to a method which the administrator shall prescribe by regulation to be promulgated not later than eighteen months after enactment of the Clean Air Act Amendments of 1990.

(C) The Administrator shall, upon application or on his own motion, by December 31, 1991, supplement data needed in support of this title and correct any factual errors in data from which affected Phase II units' baselines or actual 1985 emission rates have been calculated. Corrected data shall be used for purposes of issuing allowances under the title. Such corrections shall not be subject to judicial review, nor shall the failure of the Administrator to correct an alleged factual error in such reports be subject to judicial review.

(5) The term 'capacity factor' means the ratio between the actual electric output from a unit and the potential electric output from that unit.

(6) The term 'compliance plan' means, for purposes of the requirements of this title, either-

(A) a statement that the source will comply with all applicable requirements under this title, or

(B) where applicable, a schedule and description of the method or methods for compliance and certification by the owner or operator that the source is in compliance with the requirements of this title.

(7) The term 'continuous emission monitoring system' (CEMS) means the equipment as required by section 412, used to sample, analyze, measure, and provide on a continuous basis a permanent record of emissions and flow (expressed in pounds per million British thermal units (lbs/mmBtu), pounds per hour (lbs/hr) or such other form as the Administrator may prescribe by regulations under section 412).

(8) The term 'existing unit' means a unit (including units subject to section 111) that commenced commercial operation before the date of enactment of the Clean Air Act Amendments of 1990. Any unit that commenced commercial operation before the date of enactment of the Clean Air Act Amendments of 1990 which is modified, reconstructed, or repowered after the date of enactment of the Clean Air Act Amendments of 1990 shall continue to be an existing unit for the purposes of this title. For the purposes of this title, existing units shall not include simple combustion turbines, or units which serve a generator with a nameplate capacity of 25MWe or less.

(9) The term 'generator' means a device that produces electricity and which is reported as a generating unit pursuant to Department of Energy Form 860.

(10) The term 'new unit' means a unit that commences commercial operation on or after the date of enactment of the Clean Air Act Amendments of 1990.

(11) The term 'permitting authority' means the Administrator, or the State or local air pollution control agency, with an approved permitting program under part B of title III of the Act.

(12) The term 'repowering' means replacement of an existing coal-fired boiler with one of the following clean coal technologies: atmospheric or pressurized fluidized bed combustion, integrated gasification combined cycle, magnetohydrodynamics, direct and indirect coal-fired turbines, integrated gasification fuel cells, or as determined by the Administrator, in consultation with the Secretary of Energy, a derivative of one or more of these technologies, and any other technology capable of controlling multiple combustion emissions simultaneously with improved boiler or generation efficiency and with significantly greater waste reduction relative to the performance of technology in widespread commercial use as of the date of enactment of the Clean Air Act Amendments of 1990. Notwithstanding the provisions of section 409(a), for the purpose of this title, the term 'repowering' shall also include any oil and/or gas-fired unit which has been awarded clean coal technology demonstration funding as of January 1, 1991, by the Department of Energy.

(13) The term 'reserve' means any bank of allowances established by the Administrator under this title.

(14) The term 'State' means one of the 48 contiguous States and the District of Columbia.

(15) The term 'unit' means a fossil fuel-fired combustion device.

(16) The term 'actual 1985 emission rate', for electric utility units means the annual sulfur dioxide or nitrogen oxides emission rate in pounds per million Btu as reported in the NAPAP Emissions Inventory, Version 2, National Utility Reference File. For nonutility units, the term 'actual 1985 emission rate' means the annual sulfur dioxide or nitrogen oxides emission rate in pounds per million Btu as reported in the NAPAP Emission Inventory, Version 2.

(17)(A) The term 'utility unit' means-

(i) a unit that serves a generator in any State that produces electricity for sale, or

(ii) a unit that, during 1985, served a generator in any State that produced electricity for sale.

(B) Notwithstanding subparagraph (A), a unit described in subparagraph (A) that-

(i) was in commercial operation during 1985, but

(ii) did not, during 1985, serve a generator in any State that produced electricity for sale shall not be a utility unit for purposes of this title.

(C) A unit that cogenerates steam and electricity is not a 'utility unit' for purposes of this title unless the unit is constructed for the purpose of supplying, or commences construction after the date of enactment of this title and supplies, more than one-third of its potential electric output capacity and more than 25 megawatts electrical output to any utility power distribution system for sale.

(18) The term 'allowable 1985 emissions rate' means a federally enforceable emissions limitation for sulfur dioxide or oxides of nitrogen, applicable to the unit in 1985 or the limitation applicable in such other subsequent year as determined by the Administrator if such a limitation for 1985 does not exist. Where the emissions limitation for a unit is not expressed in pounds of emissions per million Btu, or the averaging period of that emissions limitation is not expressed on an annual basis, the Administrator shall calculate the annual equivalent of that emissions limitation in pounds per million Btu to establish the allowable 1985 emissions rate.

(19) The term 'qualifying phase I technology' means a technological system of continuous emission reduction which achieves a 90 percent reduction in emissions of sulfur dioxide from the emissions that would have resulted from the use of fuels which were not subject to treatment prior to combustion.

(20) The term 'alternative method of compliance' means a method of compliance in accordance with one or more of the following authorities:

(A) a substitution plan submitted and approved in accordance with subsections 404 (b) and (c);

(B) a Phase I extension plan approved by the Administrator under section 404(d), using qualifying phase I technology as determined by the Administrator in accordance with that section; or

(C) repowering with a qualifying clean coal technology under section 409.

(21) The term 'commenced' as applied to construction of any new electric utility unit means that an owner or operator has undertaken a continuous program of construction or that an owner or operator has entered into a contractual obligation to undertake and complete, within a reasonable time, a continuous program of construction.

(22) The term 'commenced commercial operation' means to have begun to generate electricity for sale.

(23) The term 'construction' means fabrication, erection, or installation of an affected unit.

(24) The term 'industrial source' means a unit that does not serve a generator that produces electricity, a 'nonutility unit' as defined in this section, or a process source as defined in section 410(e).

(25) The term 'nonutility unit' means a unit other than a utility unit.

(26) The term 'designated representative' means a responsible person or official authorized by the owner or operator of a unit to represent the owner or operator in matters pertaining to the holding, transfer, or disposition of allowances allocated to a unit, and the submission of and compliance with permits, permit applications, and compliance plans for the unit.

(27) The term 'life-of-the-unit, firm power contractual arrangement' means a unit participation power sales agreement under which a utility or industrial customer reserves, or is entitled to receive, a specified amount or percentage of capacity and associated energy generated by a specified generating unit (or units) and pays its proportional amount of such unit's total costs, pursuant to a contract either-

(A) for the life of the unit;

(B) for a cumulative term of no less than 30 years, including contracts that permit an election for early termination; or

(C) for a period equal to or greater than 25 years or 70 percent of the economic useful life of the unit determined as of the time the unit was built, with option rights to purchase or re-lease some portion of the capacity and associated energy generated by the unit (or units) at the end of the period.

(28) The term 'basic Phase II allowance allocations' means:

(A) For calendar years 2000 through 2009 inclusive, allocations of allowances made by the Administrator pursuant to section 403 and subsections (b)(1), (3), and (4); (c)(1), (2), (3), and (5); (d)(1), (2), (4), and (5); (e); (f); (g)(1), (2), (3), (4), and (5); (h)(1); (i) and (j) of section 405.

(B) For each calendar year beginning in 2010, allocations of allowances made by the Administrator pursuant to section 403 and subsections (b)(1), (3), and (4); (c)(1), (2), (3), and (5); (d)(1), (2), (4) and (5); (e); (f); (g)(1), (2), (3), (4), and (5); (h)(1) and (3); (i) and (j) of section 405.

(29) The term 'Phase II bonus allowance allocations' means, for calendar year 2000 through 2009, inclusive, and only for such years, allocations made by the Administrator pursuant to section 403, subsections (a)(2), (b)(2), (c)(4), (d)(3) (except as otherwise provided therein), and (h)(2) of section 405, and section 406.

Sulfur Dioxide Allowance Program for
Existing and New Units [42 U.S.C. 7651b]

"(a) ALLOCATIONS OF ANNUAL ALLOWANCES FOR EXISTING AND NEW UNITS.-(1) For the emission limitation programs under this title, the Administrator shall allocate annual allowances for the unit, to be held or distributed by the designated representative of the owner or operator of each affected unit at an affected source in accordance with this title, in an amount equal to the annual tonnage emission limitation calculated under section 404, 405, 406, 409, or 410 except as otherwise specifically provided elsewhere in this title.

Except as provided in sections 405(a)(2), 405(a)(3), 409 and 410, beginning January 1, 2000, the Administrator shall not allocate annual allowances to emit sulfur dioxide pursuant to section 405 in such an amount as would result in total annual emissions of sulfur dioxide from utility units in excess

of 8.90 million tons except that the Administrator shall not take into account unused allowances carried forward by owners and operators of affected units or by other persons holding such allowances, following the year for which they were allocated. If necessary to meeting the restrictions imposed in the preceding sentence, the Administrator shall reduce, pro rata, the basic Phase II allowance allocations for each unit subject to the requirements of section 405. Subject to the provisions of section 416, the Administrator shall allocate allowances for each affected unit at an affected source annually, as provided in paragraphs (2) and (3) and section 408. Except as provided in sections 409 and 410, the removal of an existing affected unit or source from commercial operation at any time after the date of the enactment of the Clean Air Act Amendments of 1990 (whether before or after January 1, 1995, or January 1, 2000) shall not terminate or otherwise affect the allocation of allowances pursuant to section 404 or 405 to which the unit is entitled.

Allowances shall be allocated by the Administrator without cost to the recipient, except for allowances sold by the Administrator pursuant to section 416. Not later than December 31, 1991, the Administrator shall publish a proposed list of the basic Phase II allowance allocations, the Phase II bonus allowance allocations and, if applicable, allocations pursuant to section 405(a)(3) for each unit subject to the emissions limitation requirements of section 405 for the year 2000 and the year 2010. After notice and opportunity for public comment, but not later than December 31, 1992, the Administrator shall publish a final list of such allocations, subject to the provisions of section 405(a)(2). Any owner or operator of an existing unit subject to the requirements of section 405(b) or (c) who is considering applying for an extension of the emission limitation requirement compliance deadline for that unit from January 1, 2000, until not later than December 31, 2000, pursuant to section 409, shall notify the Administrator no later than March 31, 1991. Such notification shall be used as the basis for estimating the basic Phase II allowances under this subsection.

Prior to June 1, 1998, the Administrator shall publish a revised final statement of allowance allocations, subject to the provisions of section 405(a)(2) and taking into account the effect of any compliance date extensions granted pursuant to section 409 on such allocations. Any person who may make an election concerning the amount of allowances to be allocated to a unit or units shall make such election and so inform the Administrator not later than March 31, 1991, in the case of an election under section 405 (or June 30, 1991, in the case of an election under section 406). If such person fails to make such election, the Administrator shall set forth for each unit owned or operated by such person, the amount of allowances reflecting the election that would, in the judgment of the Administrator, provide the greatest benefit for the owner or operator of the unit. If such person is a Governor who may make an election under section 406 and the Governor fails to make an election, the Administrator shall set forth for each unit in the State the amount of allowances reflecting the election that would, in the judgment of the Administrator, provide the greatest benefit for units in the State.

"(b) ALLOWANCE TRANSFER SYSTEM.-Allowances allocated under this title may be transferred among designated representatives of the owners or operators of affected sources under this title and any other person who holds such allowances, as provided by the allowance system regulations to be promulgated by the Administrator not later than eighteen months after the date of enactment of the Clean Air Act Amendments of 1990. Such regulations shall establish the allowance system prescribed under this section, including, but not limited to, requirements for the allocation, transfer, and use of allowances under this title. Such regulations shall prohibit the use of any allowance prior to the calendar year for which the allowance was allocated, and shall provide, consistent with the purposes of this title, for the identification of unused allowances, and for such unused allowances to be carried forward and added to allowances allocated in subsequent years,

including allowances allocated to units subject to Phase I requirements (as described in section 404) which are applied to emissions limitations requirements in Phase II (as described in section 405). Transfers of allowances shall not be effective until written certification of the transfer, signed by a responsible official of each party to the transfer, is received and recorded by the Administrator. Such regulations shall permit the transfer of allowances prior to the issuance of such allowances. Recorded pre-allocation transfers shall be deducted by the Administrator from the number of allowances which would otherwise be allocated to the transferor, and added to those allowances allocated to the transferee. Pre-allocation transfers shall not affect the prohibition contained in this subsection against the use of allowances prior to the year for which they are allocated.

"(c) INTERPOLLUTANT TRADING.-Not later than January 1, 1994, the Administrator shall furnish to the Congress a study evaluating the environmental and economic consequences of amending this title to permit trading sulfur dioxide allowances for nitrogen oxides allowances.

"(d) ALLOWANCE TRACKING SYSTEM.-(1) The Administrator shall promulgate, not later than 18 months after the date of enactment of the Clean Air Act Amendments of 1990, a system for issuing, recording, and tracking allowances, which shall specify all necessary procedures and requirements for an orderly and competitive functioning of the allowance system. All allowance allocations and transfers shall, upon recordation by the Administrator, be deemed a part of each unit's permit requirements pursuant to section 408, without any further permit review and revision.

"(2) In order to ensure electric reliability, such regulations shall not prohibit or affect temporary increases and decreases in emissions within utility systems, power pools, or utilities entering into allowance pool agreements, that result from their operations, including emergencies and central dispatch, and such temporary emissions increases and decreases shall not require transfer of allowances among units nor shall it require recordation. The owners or operators of such units shall act through a designated representative. Notwithstanding the preceding sentence, the total tonnage of emissions in any calendar year (calculated at the end thereof) from all units in such a utility system, power pool, or allowance pool agreements shall not exceed the total allowances for such units for the calendar year concerned.

"(e) NEW UTILITY UNITS.-After January 1, 2000, it shall be unlawful for a new utility unit to emit an annual tonnage of sulfur dioxide in excess of the number of allowances to emit held for the unit by the unit's owner or operator. Such new utility units shall not be eligible for an allocation of sulfur dioxide allowances under subsection (a)(1), unless the unit is subject to the provisions of subsection (g)(2) or (3) of section 405. New utility units may obtain allowances from any person, in accordance with this title. The owner or operator of any new utility unit in violation of this subsection shall be liable for fulfilling the obligations specified in section 411 of this title.

"(f) NATURE OF ALLOWANCES.-An allowance allocated under this title is a limited authorization to emit sulfur dioxide in accordance with the provisions of this title. Such allowance does not constitute a property right. Nothing in this title or in any other provision of law shall be construed to limit the authority of the United States to terminate or limit such authorization. Nothing in this section relating to allowances shall be construed as affecting the application of, or compliance with, any other provision of this Act to an affected unit or source, including the provisions related to applicable National Ambient Air Quality Standards and State implementation plans. Nothing in this section shall be construed as requiring a change of any kind in any State law regulating electric utility rates and charges or affecting any State law regarding such State regulation or as limiting State regulation (including any prudency review) under such a State law. Nothing in this section shall be

construed as modifying the Federal Power Act or as affecting the authority of the Federal Energy Regulatory Commission under that Act. Nothing in this title shall be construed to interfere with or impair any program for competitive bidding for power supply in a State in which such program is established. Allowances, once allocated to a person by the Administrator, may be received, held, and temporarily or permanently transferred in accordance with this title and the regulations of the Administrator without regard to whether or not a permit is in effect under title V or section 408 with respect to the unit for which such allowance was originally allocated and recorded. Each permit under this title and each permit issued under title V for any affected unit shall provide that the affected unit may not emit an annual tonnage of sulfur dioxide in excess of the allowances held for that unit.

"(g) PROHIBITION.-It shall be unlawful for any person to hold, use, or transfer any allowance allocated under this title, except in accordance with regulations promulgated by the Administrator. It shall be unlawful for any affected unit to emit sulfur dioxide in excess of the number of allowances held for that unit for that year by the owner or operator of the unit. Upon the allocation of allowances under this title, the prohibition contained in the preceding sentence shall supersede any other emission limitation applicable under this title to the units for which such allowances are allocated. Allowances may not be used prior to the calendar year for which they are allocated. Nothing in this section or in the allowance system regulations shall relieve the Administrator of the Administrator's permitting, monitoring and enforcement obligations under this Act, nor relieve affected sources of their requirements and liabilities under this Act.

"(h) COMPETITIVE BIDDING FOR POWER SUPPLY.-Nothing in this title shall be construed to interfere with or impair any program for competitive bidding for power supply in a State in which such program is established.

"(i) APPLICABILITY OF THE ANTITRUST LAWS.-

"(1) Nothing in this section affects-

"(A) the applicability of the antitrust laws to the transfer, use, or sale of allowances, or

"(B) the authority of the Federal Energy Regulatory Commission under any provision of law respecting unfair methods of competition or anticompetitive acts or practices.

"(2) As used in this section, 'antitrust laws' means those Acts set forth in section 1 of the Clayton Act (15 U.S.C. 12), as amended.

"(j) PUBLIC UTILITY HOLDING COMPANY ACT.-The acquisition or disposition of allowances pursuant to this title including the issuance of securities or the undertaking of any other financing transaction in connection with such allowances shall not be subject to the provisions of the Public Utility Holding Company Act of 1935.

Section 404 Phase I Sulfur Dioxide
Requirements [42 U.S.C. 7651c]

(a) Emission Limitations.--

(1) After January 1, 1995, each source that includes one or more affected units listed in table A is an

affected source under this section. After January 1, 1995, it shall be unlawful for any affected unit (other than an eligible phase I unit under section 404(d)(2)) to emit sulfur dioxide in excess of the tonnage limitation stated as a total number of allowances in table A for phase I, unless (A) the emissions reduction requirements applicable to such unit have been achieved pursuant to subsection (b) or (d), or (B) the owner or operator of such unit holds allowances to emit not less than the unit's total annual emissions, except that, after January 1, 2000, the emissions limitations established in this section shall be superseded by those established in section 405. The owner or operator of any unit in violation of this section shall be fully liable for such violation including, but not limited to, liability for fulfilling the obligations specified in section 411.

(2) Not later than December 31, 1991, the Administrator shall determine the total tonnage of reductions in the emissions of sulfur dioxide from all utility units in calendar year 1995 that will occur as a result of compliance with the emissions limitation requirements of this section, and shall establish a reserve of allowances equal in amount to the number of tons determined thereby not to exceed a total of 3.50 million tons. In making such a determination, the Administrator shall compute for each unit subject to the emissions limitation requirements of this section the difference between:

(A) the product of its baseline multiplied by the lesser of each unit's allowable 1985 emissions rate and its actual 1985 emissions rate, divided by 2,000, and

(B) the product of each unit's baseline multiplied by 2.50 lbs/mmBtu divided by 2,000, and sum the computations. The Administrator shall adjust the foregoing calculation to reflect projected calendar year 1995 utilization of the units subject to the emissions limitations of this title that the Administrator finds would have occurred in the absence of the imposition of such requirements. Pursuant to subsection (d), the Administrator shall allocate allowances from the reserve established hereinunder until the earlier of such time as all such allowances in the reserve are allocated or December 31, 1999.

(3) In addition to allowances allocated pursuant to paragraph (1), in each calendar year beginning in 1995 and ending in 1999, inclusive, the Administrator shall allocate for each unit on Table A that is located in the States of Illinois, Indiana, or Ohio (other than units at Kyger Creek, Clifty Creek and Joppa Steam), allowances in an amount equal to 200,000 multiplied by the unit's pro rata share of the total number of allowances allocated for all units on Table A in the 3 States (other than units at Kyger Creek, Clifty Creek, and Joppa Steam) pursuant to paragraph (1). Such allowances shall be excluded from the calculation of the reserve under paragraph (2).

(b) Substitutions.--The owner or operator of an affected unit under subsection (a) may include in its section 408 permit application and proposed compliance plan a proposal to reassign, in whole or in part, the affected unit's sulfur dioxide reduction requirements to any other unit(s) under the control of such owner or operator. Such proposal shall specify--

(1) the designation of the substitute unit or units to which any part of the reduction obligations of subsection (a) shall be required, in addition to, or in lieu of, any original affected units designated under such subsection;

(2) the original affected unit's baseline, the actual and allowable 1985 emissions rate for sulfur dioxide, and the authorized annual allowance allocation stated in table A;

(3) calculation of the annual average tonnage for calendar years 1985, 1986, and 1987, emitted by

the substitute unit or units, based on the baseline for each unit, as defined in section 402(d), multiplied by the lesser of the unit's actual or allowable 1985 emissions rate;

(4) The emissions rate and tonnage limitations that would be applicable to the original and substitute affected units under the substitution proposal;

(5) documentation, to the satisfaction of the Administrator, that the reassigned tonnage limits will, in total, achieve the same or greater emissions reduction than would have been achieved by the original affected unit and the substitute unit or units without such substitution; and

(6) such other information as the Administrator may require.

(c) Administrator's Action on Substitution Proposals.--(1) The Administrator shall take final action on such substitution proposal in accordance with section 408(c) if the substitution proposal fulfills the requirements of this subsection. The Administrator may approve a substitution proposal in whole or in part and with such modifications or conditions as may be consistent with the orderly functioning of the allowance system and which will ensure the emissions reductions contemplated by this title. If a proposal does not meet the requirements of subsection (b), the Administrator shall disapprove it. The owner or operator of a unit listed in table A shall not substitute another unit or units without the prior approval of the Administrator.

(2) Upon approval of a substitution proposal, each substitute unit, and each source with such unit, shall be deemed affected under this title, and the Administrator shall issue a permit to the original and substitute affected source and unit in accordance with the approved substitution plan and section 408. The Administrator shall allocate allowances for the original and substitute affected units in accordance with the approved substitution proposal pursuant to section 403. It shall be unlawful for any source or unit that is allocated allowances pursuant to this section to emit sulfur dioxide in excess of the emissions limitation provided for in the approved substitution permit and plan unless the owner or operator of each unit governed by the permit and approved substitution plan holds allowances to emit not less than the unit's total annual emissions. The owner or operator of any original or substitute affected unit operated in violation of this subsection shall be fully liable for such violation, including liability for fulfilling the obligations specified in section 411 of this title. If a substitution proposal is disapproved, the Administrator shall allocate allowances to the original affected unit or units in accordance with subsection (a).

(d) Eligible Phase I Extension Units.--

(1) The owner or operator of any affected unit subject to an emissions limitation requirement under this section may petition the Administrator in its permit application under section 408 for an extension of 2 years of the deadline for meeting such requirement, provided that the owner or operator of any such unit holds allowances to emit not less than the unit's total annual emissions for each of the 2 years of the period of extension. To qualify for such an extension, the affected unit must either employ a qualifying phase I technology, or transfer its phase I emissions reduction obligation to a unit employing a qualifying phase I technology. Such transfer shall be accomplished in accordance with a compliance plan, submitted and approved under section 408, that shall govern operations at all units included in the transfer, and that specifies the emissions reduction requirements imposed pursuant to this title.

(2) Such extension proposal shall--

(A) specify the unit or units proposed for designation as an eligible phase I extension unit;

(B) provide a copy of an executed contract, which may be contingent upon the Administrator approving the proposal, for the design engineering, and construction of the qualifying phase I technology for the extension unit, or for the unit or units to which the extension unit's emission reduction obligation is to be transferred;

(C) specify the unit's or units' baseline, actual 1985 emissions rate, allowable 1985 emissions rate, and projected utilization for calendar years 1995 through 1999;

(D) require CEMS on both the eligible phase I extension unit or units and the transfer unit or units beginning no later than January 1, 1995; and

(E) specify the emission limitation and number of allowances expected to be necessary for annual operation after the qualifying phase I technology has been installed.

(3) The Administrator shall review and take final action on each extension proposal in order of receipt, consistent with section 408, and for an approved proposal shall designate the unit or units as an eligible phase I extension unit. The Administrator may approve an extension proposal in whole or in part, and with such modifications or conditions as may be necessary, consistent with the orderly functioning of the allowance system, and to ensure the emissions reductions contemplated by the title.

(4) In order to determine the number of proposals eligible for allocations from the reserve under subsection (a)(2) and the number of allowances remaining available after each proposal is acted upon, the Administrator shall reduce the total number of allowances remaining available in the reserve by the number of allowances calculated according to subparagraphs (A), (B) and (C) until either no allowances remain available in the reserve for further allocation or all approved proposals have been acted upon. If no allowances remain available in the reserve for further allocation before all proposals have been acted upon by the Administrator, any pending proposals shall be disapproved. The Administrator shall calculate allowances equal to--

(A) the difference between the lesser of the average annual emissions in calendar years 1988 and 1989 or the projected emissions tonnage for calendar year 1995 or each eligible phase I extension unit, as designated under paragraph (3), and the product of the unit's baseline multiplied by an emission rate of 2.50 lbs/mmBtu, divided by 2,000;

(B) the difference between the lesser of the average annual emissions in calendar years 1988 and 1989 or the projected emissions tonnage for calendar year 1996 of each eligible phase I extension unit, as designated under paragraph (3), and the product of the unit's baseline multiplied by an emission rate of 2.50 lbs/mmBtu, divided by 2,000; and

(C) the amount by which (i) the product of each unit's baseline multiplied by an emission rate of 1.20 lbs/mmBtu, divided by 2,000, exceeds (ii) the tonnage level specified under subparagraph (E) of paragraph (2) of this subsection multiplied by a factor of 3.

(5) Each eligible Phase I extension unit shall receive allowances determined under subsection (a)(1) or (c) of this section. In addition, for calendar year 1995, the Administrator shall allocate to each eligible Phase I extension unit, from the allowance reserve created pursuant to subsection (a)(2),

allowances equal to the difference between the lesser of the average annual emissions in calendar years 1988 and 1989 or its projected emissions tonnage for calendar year 1995 and the product of the unit's baseline multiplied by an emission rate of 2.50 lbs/mmBtu, divided by 2,000. In calendar year 1996, the Administrator shall allocate for each eligible unit, from the allowance reserve created pursuant to subsection (a)(2), allowances equal to the difference between the lesser of the average annual emissions in calendar years 1988 and 1989 or its projected emissions tonnage for calendar year 1996 and the product of the unit's baseline multiplied by an emission rate of 2.50 lbs/mmBtu, divided by 2,000. It shall be unlawful for any source or unit subject to an approved extension plan under this subsection to emit sulfur dioxide in excess of the emissions limitations provided for in the permit and approved extension plan, unless the owner or operator of each unit governed by the permit and approved plan holds allowances to emit not less than the unit's total annual emissions.

(6) In addition to allowances specified in paragraph (5), the Administrator shall allocate for each eligible Phase I extension unit employing qualifying Phase I technology, for calendar years 1997, 1998, and 1999, additional allowances, from any remaining allowances in the reserve created pursuant to subsection (a)(2), following the reduction in the reserve provided for in paragraph (4), not to exceed the amount by which (A) the product of each eligible unit's baseline times an emission rate of 1.20 lbs/mmBtu, divided by 2,000, exceeds (B) the tonnage level specified under subparagraph (E) of paragraph (2) of this subsection.

(7) After January 1, 1997, in addition to any liability under this Act, including under section 411, if any eligible phase I extension unit employing qualifying phase I technology or any transfer unit under this subsection emits sulfur dioxide in excess of the annual tonnage limitation specified in the extension plan, as approved in paragraph (3) of this subsection, the Administrator shall, in the calendar year following such excess, deduct allowances equal to the amount of such excess from such unit's annual allowance allocation.

Section 405 Phase II Sulfur Dioxide Requirements. [42 U.S.C. 7651d]

(a) Applicability.- (1) After January 1, 2000, each existing utility unit as provided below is subject to the limitations or requirements of this section. Each utility unit subject to an annual sulfur dioxide tonnage emission limitation under this section is an affected unit under this title. Each source that includes one or more affected units is an affected source. In the case of an existing unit that was not in operation during calendar year 1985, the emission rate for a calendar year after 1985, as determined by the Administrator, shall be used in lieu of the 1985 rate. The owner or operator of any unit operated in violation of this section shall be fully liable under this Act for fulfilling the obligations specified in section 411 of this title.

(2) In addition to basic Phase II allowance allocations, in each year beginning in calendar year 2000 and ending in calendar year 2009, inclusive, the Administrator shall allocate up to 530,000 Phase II bonus allowances pursuant to subsections (b)(2),

(c)(4), (d)(3)(A) and (B), and (h)(2) of this section and section 406. Not later than June 1, 1998, the Administrator shall calculate, for each unit granted an extension pursuant to section 409 the difference between (A) the number of allowances allocated for the unit in calendar year 2000, and (B) the product of the unit's baseline multiplied by 1.20 lbs/mmBtu, divided by 2000, and sum the computations. In each year, beginning in calendar year 2000 and ending in calendar year 2009, inclusive, the Administrator shall deduct from each unit's basic Phase II allowance allocation its pro rata share of 10 percent of the sum calculated pursuant to the preceding sentence.

(3) In addition to basic Phase II allowance allocations and Phase II bonus allowance allocations, beginning January 1, 2000, the Administrator shall allocate for each unit listed on Table A in section 404 (other than units at Kyger Creek, Clifty Creek, and Joppa Steam) and located in the States of Illinois, Indiana, Ohio, Georgia, Alabama, Missouri, Pennsylvania, West Virginia, Kentucky, or Tennessee allowances in an amount equal to 50,000 multiplied by the unit's pro rata share of the total number of basic allowances allocated for all units listed on Table A (other than units at Kyger Creek, Clifty Creek, and Joppa Steam). Allowances allocated pursuant to this paragraph shall not be subject to the 8,900,000 ton limitation in section 403(a).

(b) Units Equal to, or Above, 75 MWe and 1.20 lbs/mmBtu.- (1) Except as otherwise provided in paragraph (3), after January 1, 2000, it shall be unlawful for any existing utility unit that serves a generator with nameplate capacity equal to, or greater, than 75 MWe and an actual 1985 emission rate equal to or greater than 1.20 lbs/mmBtu to exceed an annual sulfur dioxide tonnage emission limitation equal to the product of the unit's baseline multiplied by an emission rate equal to 1.20 lbs/mmBtu, divided by 2,000, unless the owner or operator of such unit holds allowances to emit not less than the unit's total annual emissions.

(2) In addition to allowances allocated pursuant to paragraph (1) and section 403(a)(1) as basic Phase II allowance allocations, beginning January 1, 2000, and for each calendar year thereafter until and including 2009, the Administrator shall allocate annually for each unit subject to the emissions limitation requirements of paragraph (1) with an actual 1985 emissions rate greater than 1.20 lbs/mmBtu and less than 2.50 lbs/mmBtu and a baseline capacity factor of less than 60 percent, allowances from the reserve created pursuant to subsection (a)(2) in an amount equal to 1.20 lbs/mmBtu multiplied by 50 percent of the difference, on a Btu basis, between the unit's baseline and the unit's fuel consumption at a 60 percent capacity factor.

(3) After January 1, 2000, it shall be unlawful for any existing utility unit with an actual 1985 emissions rate equal to or greater than 1.20 lbs/mmBtu whose annual average fuel consumption during 1985, 1986, and 1987 on a Btu basis exceeded 90 percent in the form of lignite coal which is located in a State in which, as of July 1, 1989, no county or portion of a county was designated nonattainment under section 107 of this Act for any pollutant subject to the requirements of section 109 of this Act to exceed an annual sulfur dioxide tonnage limitation equal to the product of the unit's baseline multiplied by the lesser of the unit's actual 1985 emissions rate or its allowable 1985 emissions rate, divided by 2,000, unless the owner or operator of such unit holds allowances to emit not less than the unit's total annual emissions.

(4) After January 1, 2000, the Administrator shall allocate annually for each unit, subject to the emissions limitation requirements of paragraph (1), which is located in a State with an installed electrical generating capacity of more than 30,000,000 kw in 1988 and for which was issued a prohibition order or a proposed prohibition order (from burning oil), which unit subsequently converted to coal between January 1, 1980 and December 31, 1985, allowances equal to the difference between (A) the product of the unit's annual fuel consumption, on a Btu basis, at a 65 percent capacity factor multiplied by the lesser of its actual or allowable emissions rate during the first full calendar year after conversion, divided by 2,000, and (B) the number of allowances allocated for the unit pursuant to paragraph (1): Provided, That the number of allowances allocated pursuant to this paragraph shall not exceed an annual total of five thousand.

If necessary to meeting the restriction imposed in the preceding sentence the Administrator shall reduce, pro rata, the annual allowances allocated for each unit under this paragraph.

(c) Coal or Oil-fired Units Below 75 MWe and Above 1.20 lbs/mmBtu.- (1) Except as otherwise provided in paragraph (3), after January 1, 2000, it shall be unlawful for a coal or oil-fired existing utility unit that serves a generator with nameplate capacity of less than 75 MWe and an actual 1985 emission rate equal to, or greater than, 1.20 lbs/mmBtu and which is a unit owned by a utility operating company whose aggregate nameplate fossil fuel steam-electric capacity is, as of December 31, 1989, equal to, or greater than, 250 MWe to exceed an annual sulfur dioxide emissions limitation equal to the product of the unit's baseline multiplied by an emission rate equal to 1.20 lbs/mmBtu, divided by 2,000, unless the owner or operator of such unit holds allowances to emit not less than the unit's total annual emissions.

(2) After January 1, 2000, it shall be unlawful for a coal or oil-fired existing utility unit that serves a generator with nameplate capacity of less than 75 MWe and an actual 1985 emission rate equal to, or greater than, 1.20 lbs/mmBtu (excluding units subject to section 111 of the Act or to a federally enforceable emissions limitation for sulfur dioxide equivalent to an annual rate of less than 1.20 lbs/mmBtu) and which is a unit owned by a utility operating company whose aggregate nameplate fossil fuel steam-electric capacity is, as of December 31, 1989, less than 250 MWe, to exceed an annual sulfur dioxide tonnage emissions limitation equal to the product of the unit's baseline multiplied by the lesser of its actual 1985 emissions rate or its allowable 1985 emissions rate, divided by 2,000, unless the owner or operator of such unit holds allowances to emit not less than the unit's total annual emissions.

(3) After January 1, 2000 it shall be unlawful for any existing utility unit with a nameplate capacity below 75 MWe and an actual 1985 emissions rate equal to, or greater than, 1.20 lbs/mmBtu which became operational on or before December 31, 1965, which is owned by a utility operating company with, as of December 31, 1989, a total fossil fuel steam-electric generating capacity greater than 250 MWe, and less than 450 MWe which serves fewer than 78,000 electrical customers as of the date of enactment of the Clean Air Act Amendments of 1990 to exceed an annual sulfur dioxide emissions tonnage limitation equal to the product of its baseline multiplied by the lesser of its actual or allowable 1985 emission rate, divided by 2,000, unless the owner or operator holds allowances to emit not less than the units total annual emissions. After January 1, 2010, it shall be unlawful for each unit subject to the emissions limitation requirements of this paragraph to exceed an annual emissions tonnage limitation equal to the product of its baseline multiplied by an emissions rate of 1.20 lbs/mmBtu, divided by 2,000, unless the owner or operator holds allowances to emit not less than the unit's total annual emissions.

(4) In addition to allowances allocated pursuant to paragraph (1) and section 403(a)(1) as basic Phase II allowance allocations, beginning January 1, 2000, and for each calendar year thereafter until and including 2009, inclusive, the Administrator shall allocate annually for each unit subject to the emissions limitation requirements of paragraph (1) with an actual 1985 emissions rate equal to, or greater than, 1.20 lbs/mmBtu and less than 2.50 lbs/mmBtu and a baseline capacity factor of less than 60 percent, allowances from the reserve created pursuant to subsection (a)(2) in an amount equal to 1.20 lbs/mmBtu multiplied by 50 percent of the difference, on a Btu basis, between the unit's baseline and

the unit's fuel consumption at a 60 percent capacity factor.

(5) After January 1, 2000, it shall be unlawful for any existing utility unit with a nameplate capacity below 75 MWe and an actual 1985 emissions rate equal to, or greater than, 1.20 lbs/mmBtu which is part of an electric utility system which, as of the date of the enactment of the Clean Air Act Amendments of 1990, (A) has at least 20 percent of its fossil-fuel capacity controlled by flue gas desulfurization devices, (B) has more than 10 percent of its fossil-fuel capacity consisting of coal-fired units of less than 75 MWe, and (C) has large units (greater than 400 MWe) all of which have difficult or very difficult FGD Retrofit Cost Factors (according to the Emissions and the FGD Retrofit Feasibility at the 200 Top Emitting Generating Stations, prepared for the United States Environmental Protection Agency on January 10, 1986) to exceed an annual sulfur dioxide emissions tonnage limitation equal to the product of its baseline multiplied by an emissions rate of 2.5 lbs/mmBtu, divided by 2,000, unless the owner or operator holds allowances to emit not less than the unit's total annual emissions. After January 1, 2010, it shall be unlawful for each unit subject to the emissions limitation requirements of this paragraph to exceed an annual emissions tonnage limitation equal to the product of its baseline multiplied by an emissions rate of 1.20 lbs/mmBtu, divided by 2,000, unless the owner or operator holds for use allowances to emit not less than the unit's total annual emissions.

(d) Coal-fired Units Below 1.20 lbs/mmBtu.- (1) After January 1, 2000, it shall be unlawful for any existing coal-fired utility unit the lesser of whose actual or allowable 1985 sulfur dioxide emissions rate is less than 0.60 lbs/mmBtu to exceed an annual sulfur dioxide tonnage emission limitation equal to the product of the unit's baseline multiplied by (A) the lesser of 0.60 lbs/mmBtu or the unit's allowable 1985 emissions rate, and (B) a numerical factor of 120 percent, divided by 2,000, unless the owner or operator of such unit holds allowances to emit not less than the unit's total annual emissions.

(2) After January 1, 2000, it shall be unlawful for any existing coal-fired utility unit the lesser of whose actual or allowable 1985 sulfur dioxide emissions rate is equal to, or greater than, 0.60 lbs/mmBtu and less than 1.20 lbs/mmBtu to exceed an annual sulfur dioxide tonnage emissions limitation equal to the product of the unit's baseline multiplied by (A) the lesser of its actual 1985 emissions rate or its allowable 1985 emissions rate, and (B) a numerical factor of 120 percent, divided by 2,000, unless the owner or operator of such unit holds allowances to emit not less than the unit's total annual emissions.

(3)(A) In addition to allowances allocated pursuant to paragraph (1) and section 403(a)(1) as basic Phase II allowance allocations,

at the election of the designated representative of the operating company, beginning January 1, 2000, and for each calendar year thereafter until and including 2009, the Administrator shall allocate annually for each unit subject to the emissions limitation requirements of paragraph (1) allowances from the reserve created pursuant to subsection (a)(2) in an amount equal to the amount by which (i) the product of the lesser of 0.60 lbs/mmBtu or the unit's allowable 1985 emissions rate multiplied by the unit's baseline adjusted to reflect operation at a 60 percent capacity factor, divided by 2,000, exceeds (ii) the number of allowances allocated for the unit pursuant to paragraph (1) and section 403(a)(1) as basic Phase II allowance allocations.

(B) In addition to allowances allocated pursuant to paragraph (2) and section 403(a)(1) as basic Phase II allowance allocations, at the election of the designated representative of the operating company, beginning January 1, 2000, and for each calendar year thereafter until and including 2009, the Administrator shall allocate annually for each unit subject to the emissions limitation requirements of paragraph (2) allowances from the reserve created pursuant to subsection (a)(2) in an amount equal to the amount by which (i) the product of the lesser of the unit's actual 1985 emissions rate or its allowable 1985 emissions rate multiplied by the unit's baseline adjusted to reflect operation at a 60 percent capacity factor, divided by 2,000, exceeds (ii) the number of allowances allocated for the unit pursuant to paragraph (2) and section 403(a)(1) as basic Phase II allowance allocations.

(C) An operating company with units subject to the emissions limitation requirements of this subsection may elect the allocation of allowances as provided under subparagraphs (A) and (B). Such election shall apply to the annual allowance allocation for each and every unit in the operating company subject to the emissions limitation requirements of this subsection. The Administrator shall allocate allowances pursuant to subparagraphs (A) and (B) only in accordance with this subparagraph.

(4) Notwithstanding any other provision of this section, at the election of the owner or operator, after January 1, 2000, the Administrator shall allocate in lieu of allocation, pursuant to paragraph (1), (2), (3), (5), or (6), allowances for a unit subject to the emissions limitation requirements of this subsection which commenced commercial operation on or after January 1, 1981 and before December 31, 1985, which was subject to, and in compliance with, section 111 of the Act in an amount equal to the unit's annual fuel consumption, on a Btu basis, at a 65 percent

capacity factor multiplied by the unit's allowable 1985 emissions rate, divided by 2,000.

(5) For the purposes of this section, in the case of an oil- and gas-fired unit which has been awarded a clean coal technology demonstration grant as of January 1, 1991, by the United States Department of Energy, beginning January 1, 2000, the Administrator shall allocate for the unit allowances in an amount equal to the unit's baseline multiplied by 1.20 lbs/mmBtu, divided by 2,000.

(e) Oil and Gas-fired Units Equal to or Greater Than 0.60 lbs/mmBtu and Less Than 1.20 lbs/mmBtu.- After January 1, 2000, it shall be unlawful for any existing oil and gas-fired utility unit the lesser of whose actual or allowable 1985 sulfur dioxide emission rate is equal to, or greater than, 0.60 lbs/mmBtu, but less than 1.20 lbs/mmBtu to exceed an annual sulfur dioxide tonnage limitation equal to the product of the unit's baseline multiplied by (A) the lesser of the unit's allowable 1985 emissions rate or its actual 1985 emissions rate and (B) a numerical factor of 120 percent divided by 2,000, unless the owner or operator of such unit holds allowances to emit not less than the unit's total annual emissions.

(f) Oil and Gas-fired Units Less Than 0.60 lbs/mmBtu.- (1) After January 1, 2000, it shall be unlawful for any oil and gas-fired existing utility unit the lesser of whose actual or allowable 1985 emission rate is less than 0.60 lbs/mmBtu and

whose average annual fuel consumption during the period 1980 through 1989 on a Btu basis was 90 percent or less in the form of natural gas to exceed an annual sulfur dioxide tonnage emissions limitation equal to the product of the unit's baseline multiplied by (A) the lesser of 0.60 lbs/mmBtu or the unit's allowable 1985 emissions, and (B) a numerical factor of 120 percent, divided by 2,000, unless the owner or operator of such unit holds allowances to emit not less than the unit's total annual emissions.

(2) In addition to allowances allocated pursuant to paragraph

(1) as basic Phase II allowance allocations and section

403(a)(1), beginning January 1, 2000, the Administrator shall, in

the case of any unit operated by a utility that furnishes

electricity, electric energy, steam, and natural gas within an

area consisting of a city and 1 contiguous county, and in the

case of any unit owned by a State authority, the output of which

unit is furnished within that same area consisting of a city and

1 contiguous county, the Administrator shall allocate for each

unit in the utility its pro rata share of 7,000 allowances and

for each unit in the State authority its pro rata share of 2,000

allowances.

(g) Units That Commence Operation Between 1986 and December 31,

1995. (1) After January 1, 2000, it shall be unlawful for any

utility unit that has commenced commercial operation on or after

January 1, 1986, but not later than September 30, 1990 to exceed

an annual tonnage emission limitation equal to the product of the

unit's annual fuel consumption, on a Btu basis, at a 65 percent capacity factor multiplied by the unit's allowable 1985 sulfur dioxide emission rate (converted, if necessary, to pounds per mmBtu), divided by 2,000 unless the owner or operator of such unit holds allowances to emit not less than the unit's total annual emissions.

(2) After January 1, 2000, the Administrator shall allocate allowances pursuant to section 403 to each unit which is listed in table B of this paragraph in an annual amount equal to the amount specified in table B.

Table B

(Note: To view this table you need an HTML 3.0-compatible browser such as NetScape 1.1 or Mosaic 2.0.0 Beta 4.

If you prefer, Download a compressed file containing Table B in Wordperfect 6.1 format)

Notwithstanding any other paragraph of this subsection, for units subject to this paragraph, the Administrator shall not allocate allowances pursuant to any other paragraph of this subsection, Provided that the owner or operator of a unit listed on Table B may elect an allocation of allowances under another paragraph of this subsection in lieu of an allocation under this paragraph.

(3) Beginning January 1, 2000, the Administrator shall allocate to the owner or operator of any utility unit that commences commercial operation, or has commenced commercial operation, on or after October 1, 1990, but not later than December 31, 1992 allowances in an amount equal to the product of the unit's annual fuel consumption, on a Btu basis, at a 65 percent capacity factor

multiplied by the lesser of 0.30 lbs/mmBtu or the unit's allowable sulfur dioxide emission rate (converted, if necessary, to pounds per mmBtu), divided by 2,000.

(4) Beginning January 1, 2000, the Administrator shall allocate to the owner or operator of any utility unit that has commenced construction before December 31, 1990 and that commences commercial operation between January 1, 1993 and December 31, 1995, allowances in an amount equal to the product of the unit's annual fuel consumption, on a Btu basis, at a 65 percent capacity factor multiplied by the lesser of 0.30 lbs/mmBtu or the unit's allowable sulfur dioxide emission rate (converted, if necessary, to pounds per mmBtu), divided by 2,000.

(5) After January 1, 2000, it shall be unlawful for any existing utility unit that has completed conversion from predominantly gas fired existing operation to coal fired operation between January 1, 1985 and December 31, 1987, for which there has been allocated a proposed or final prohibition order pursuant to section 301(b) of the Powerplant and Industrial Fuel Use Act of 1978 (42 U.S.C. 8301 et seq, repealed 1987) to exceed an annual sulfur dioxide tonnage emissions limitation equal to the product of the unit's annual fuel consumption, on a Btu basis, at a 65 percent capacity factor multiplied by the lesser of 1.20 lbs/mmBtu or the unit's allowable 1987 sulfur dioxide emissions rate, divided by 2,000, unless the owner or operator of such unit has obtained allowances equal to its actual

emissions.

(6)(A) Unless the Administrator has approved a designation of such facility under section 410, the provisions of this title shall not apply to a "qualifying small power production facility" or "qualifying cogeneration facility" (within the meaning of section 3(17)(C) or 3(18)(B) of the Federal Power Act) or to a "new independent power production facility" as defined in section 416 except that clause (iii) of such definition in section 416 shall not apply for purposes of this paragraph if, as of the date of enactment,

(i) an applicable power sales agreement has been executed;

(ii) the facility is the subject of a State regulatory authority order requiring an electric utility to enter into a power sales agreement with, purchase capacity from, or (for purposes of establishing terms and conditions of the electric utility's purchase of power) enter into arbitration concerning, the facility;

(iii) an electric utility has issued a letter of intent or similar instrument committing to purchase power from the facility at a previously offered or lower price and a power sales agreement is executed within a reasonable period of time; or

(iv) the facility has been selected as a winning bidder in a utility competitive bid solicitation.

(h) Oil and Gas-fired Units Less Than 10 Percent Oil Consumed.-

(1) After January 1, 2000, it shall be unlawful for any oil- and gas-fired utility unit whose average annual fuel consumption during the period 1980 through 1989 on a Btu basis exceeded 90 percent in the form of natural gas to exceed an annual sulfur dioxide tonnage limitation equal to the product of the unit's baseline multiplied by the unit's actual 1985 emissions rate divided by 2,000 unless the owner or operator of such unit holds allowances to emit not less than the unit's total annual emissions.

(2) In addition to allowances allocated pursuant to paragraph (1) and section 403(a)(1) as basic Phase II allowance allocations, beginning January 1, 2000, and for each calendar year thereafter until and including 2009, the Administrator shall allocate annually for each unit subject to the emissions limitation requirements of paragraph (1) allowances from the reserve created pursuant to subsection (a)(2) in an amount equal to the unit's baseline multiplied by 0.050 lbs/mmBtu, divided by 2,000.

(3) In addition to allowances allocated pursuant to paragraph (1) and section 403(a)(1), beginning January 1, 2010, the Administrator shall allocate annually for each unit subject to the emissions limitation requirements of paragraph (1) allowances in an amount equal to the unit's baseline multiplied by 0.050 lbs/mmBtu, divided by 2,000.

(i) Units in High Growth States.- (1) In addition to

allowances allocated pursuant to this section and section 403(a)(1) as basic Phase II allowance allocations, beginning January 1, 2000, the Administrator shall allocate annually allowances for each unit, subject to an emissions limitation requirement under this section, and located in a State that-

(A) has experienced a growth in population in excess of 25 percent between 1980 and 1988 according to State Population and Household Estimates, With Age, Sex, and Components of Change: 1981-1988 allocated by the United States Department of Commerce, and

(B) had an installed electrical generating capacity of more than 30,000,000 kw in 1988,

in an amount equal to the difference between (A) the number of allowances that would be allocated for the unit pursuant to the emissions limitation requirements of this section applicable to the unit adjusted to reflect the unit's annual average fuel consumption on a Btu basis of any three consecutive calendar years between 1980 and 1989 (inclusive) as elected by the owner or operator and (B) the number of allowances allocated for the unit pursuant to the emissions limitation requirements of this section: Provided, That the number of allowances allocated pursuant to this subsection shall not exceed an annual total of 40,000. If necessary to meeting the 40,000 allowance restriction imposed under this subsection the Administrator shall reduce, pro rata, the additional annual allowances allocated to each unit

under this subsection.

(2) Beginning January 1, 2000, in addition to allowances allocated pursuant to this section and section 403(a)(1) as basic Phase II allowance allocations, the Administrator shall allocate annually for each unit subject to the emissions limitation requirements of subsection (b)(1), (A) the lesser of whose actual or allowable 1980 emissions rate has declined by 50 percent or more as of the date of enactment of the Clean Air Act Amendments of 1990, (B) whose actual emissions rate is less than 1.2 lbs/mmBtu as of January 1, 2000, (C) which commenced operation after January 1, 1970, (D) which is owned by a utility company whose combined commercial and industrial kilowatt-hour sales have increased by more than 20 percent between calendar year 1980 and the date of enactment of the Clean Air Act Amendments of 1990, and (E) whose company-wide fossil-fuel sulfur dioxide emissions rate has declined 40 per centum or more from 1980 to 1988, allowances in an amount equal to the difference between (i) the number of allowances that would be allocated for the unit pursuant to the emissions limitation requirements of subsection (b)(1) adjusted to reflect the unit's annual average fuel consumption on a Btu basis for any three consecutive years between 1980 and 1989 (inclusive) as elected by the owner or operator and (ii) the number of allowances allocated for the unit pursuant to the emissions limitation requirements of subsection (b)(1): Provided, That the number of allowances allocated

pursuant to this paragraph shall not exceed an annual total of 5,000. If necessary to meeting the 5,000 allowance restriction imposed in the last clause of the preceding sentence the Administrator shall reduce, pro rata, the additional allowances allocated to each unit pursuant to this paragraph.

(j) Certain Municipally Owned Power Plants.- Beginning January 1, 2000, in addition to allowances allocated pursuant to this section and section 403(a)(1) as basic Phase II allowance allocations, the Administrator shall allocate annually for each existing municipally owned oil and gas-fired utility unit with nameplate capacity equal to, or less than, 40 MWe, the lesser of whose actual or allowable 1985 sulfur dioxide emission rate is less than 1.20 lbs/mmBtu, allowances in an amount equal to the product of the unit's annual fuel consumption on a Btu basis at a 60 percent capacity factor multiplied by the lesser of its allowable 1985 emission rate or its actual 1985 emission rate, divided by 2,000.

Section 406
Allowances for States with Emissions Rates
at or Below 0.80 Lbs/mmBTU
[42 U.S.C. 7651e]

(a) Election of Governor.--In addition to basic Phase II allowance allocations, upon the election of the Governor of any State, with a 1985 state-wide annual sulfur dioxide emissions rate equal to or less than, 0.80 lbs/mmBtu, averaged over all fossil fuel-fired utility steam generating units, beginning January 1, 2000, and for each calendar year thereafter until and including 2009, the Administrator shall allocate, in lieu of other Phase II bonus allowance allocations, allowances from the reserve created pursuant to section 405(a)(2) to all such units in the State in an amount equal to 125,000 multiplied by the unit's pro rata share of electricity generated in calendar year 1985 at fossil fuel-fired utility steam units in all States eligible for the election.

(b) Notification of Administrator.-- Pursuant to section 403(a)(1), each Governor of a State eligible

to make an election under paragraph (a) shall notify the Administrator of such election. In the event that the Governor of any such State fails to notify the Administrator of the Governor's elections, the Administrator shall allocate allowances pursuant to section 405.

(c) Allowances After January 1, 2010.--After January 1, 2010, the Administrator shall allocate allowances to units subject to the provisions of this section pursuant to section 405.

Section 407

Nitrogen Oxides Emission Reduction Program [42 U.S.C. 7651f]

(a) Applicability.--On the date that a coal-fired utility unit becomes an affected unit pursuant to sections 404, 405, 409, or on the date a unit subject to the provisions of section 404(d) or 409(b), must meet the SO₂ reduction requirements, each such unit shall become an affected unit for purposes of this section and shall be subject to the emission limitations for nitrogen oxides set forth herein.

(b) Emission Limitations.--

(1) Not later than eighteen months after enactment of the Clean Air Act Amendments of 1990, the Administrator shall by regulation establish annual allowable emission limitations for nitrogen oxides for the types of utility boilers listed below, which limitations shall not exceed the rates listed below: Provided, That the Administrator may set a rate higher than that listed for any type of utility boiler if the Administrator finds that the maximum listed rate for that boiler type cannot be achieved using low NO_x burner technology. The maximum allowable emission rates are as follows:

(A) for tangentially fired boilers, 0.45 lb/mmBtu;

(B) for dry bottom wall-fired boilers (other than units applying cell burner technology), 0.50 lb/mmBtu. After January 1, 1995, it shall be unlawful for any unit that is an affected unit on that date and is of the type listed in this paragraph to emit nitrogen oxides in excess of the emission rates set by the Administrator pursuant to this paragraph.

(2) Not later than January 1, 1997, the Administrator shall, by regulation, establish allowable emission limitations on a lb/mmBtu, annual average basis, for nitrogen oxides for the following types of utility boilers:

(A) wet bottom wall-fired boilers;

(B) cyclones;

(C) units applying cell burner technology;

(D) all other types of utility boilers. The Administrator shall base such rates on the degree of reduction achievable through the retrofit application of the best system of continuous emission reduction, taking into account available technology, costs and energy and environmental impacts; and which is comparable to the costs of nitrogen oxides controls set pursuant to subsection (b)(1). Not later than January 1, 1997, the Administrator may revise the applicable emission limitations for tangentially fired and dry bottom, wall-fired boilers (other than cell burners) to be more stringent if

the Administrator determines that more effective low NOx burner technology is available: Provided, That, no unit that is an affected unit pursuant to section 404 and that is subject to the requirements of subsection (b)(1), shall be subject to the revised emission limitations, if any.

(c) Revised Performance Standards.--

(1) Not later than January 1, 1993, the Administrator shall propose revised standards of performance to section 111 for nitrogen oxides emissions from fossil-fuel fired steam generating units, including both electric utility and nonutility units. Not later than January 1, 1994, the Administrator shall promulgate such revised standards of performance. Such revised standards of performance shall reflect improvements in methods for the reduction of emissions of oxides of nitrogen.

(d) Alternative Emission Limitations.--The permitting authority shall, upon request of an owner or operator of a unit subject to this section, authorize an emission limitation less stringent than the applicable limitation established under subsection (b)(1) or (b)(2) upon a determination that--

(1) a unit subject to subsection (b)(1) cannot meet the applicable limitation using low NOx burner technology; or

(2) a unit subject to subsection (b)(2) cannot meet the applicable rate using the technology on which the Administrator based the applicable emission limitation. The permitting authority shall base such determination upon a showing satisfactory to the permitting authority, in accordance with regulations established by the Administrator not later than eighteen months after enactment of the Clean Air Act Amendments of 1990, that the owner or operator--

(1) has properly installed appropriate control equipment designed to meet the applicable emission rate;

(2) has properly operated such equipment for a period of fifteen months (or such other period of time as the Administrator determines through the regulations), and provides operating and monitoring data for such period demonstrating that the unit cannot meet the applicable emission rate; and

(3) has specified an emission rate that such unit can meet on an annual average basis.

The permitting authority shall issue an operating permit for the unit in question, in accordance with section 408 and part B of title III--

(i) that permits the unit during the demonstration period referred to in subparagraph (2) above, to emit at a rate in excess of the applicable emission rate;

(ii) at the conclusion of the demonstration period to revise the operating permit to reflect the alternative emission rate demonstrated in paragraphs (2) and (3) above.

Units subject to subsection (b)(1) for which an alternative emission limitation is established shall not be required to install any additional control technology beyond low NOx burners. Nothing in this section shall preclude an owner or operator from installing and operating an alternative NOx control technology capable of achieving the applicable emission limitation. If the owner or operator of a unit subject to the emissions limitation requirements of subsection (b)(1) demonstrates to the satisfaction

of the Administrator that the technology necessary to meet such requirements is not in adequate supply to enable its installation and operation at the unit, consistent with system reliability, by January 1, 1995, then the Administrator shall extend the deadline for compliance for the unit by a period of 15 months. Any owner or operator may petition the Administrator to make a determination under the previous sentence. The Administrator shall grant or deny such petition within 3 months of submittal.

(e) Emissions Averaging.--In lieu of complying with the applicable emissions limitations under subsection (b)(1), (2), or (d), the owner or operator of two or more units subject to one or more of the applicable emission limitations set pursuant to these sections, may petition the permitting authority for alternative contemporaneous annual emission limitations for such units that ensure that (1) the actual annual emission rate in pounds of nitrogen oxides per million Btu averaged over the units in question is a rate that is less than or equal to (2) the Btu-weighted average annual emission rate for the same units if they had been operated, during the same period of time, in compliance with limitations set in accordance with the applicable emission rates set pursuant to subsections (b)(1) and (2).

If the permitting authority determines, in accordance with regulations issued by the Administrator not later than eighteen months after enactment of the Clean Air Act Amendments of 1990; that the conditions in the paragraph above can be met, the permitting authority shall issue operating permits for such units, in accordance with section 408 and part B of title III, that allow alternative contemporaneous annual emission limitations. Such emission limitations shall only remain in effect while both units continue operation under the conditions specified in their respective operating permits.

Section 408
Permits and Compliance Plans
[42 U.S.C. 7651g]

(a) Permit Program.--The provisions of this title shall be implemented, subject to section 403, by permits issued to units subject to this title (and enforced) in accordance with the provisions of title V, as modified by this title. Any such permit issued by the Administrator, or by a State with an approved permit program, shall prohibit--

(1) annual emissions of sulfur dioxide in excess of the number of allowances to emit sulfur dioxide the owner or operator, or the designated representative of the owners or operators, of the unit hold for the unit,

(2) exceedances of applicable emissions rates,

(3) the use of any allowance prior to the year for which it was allocated, and

(4) contravention of any other provision of the permit.

Permits issued to implement this title shall be issued for a period of 5 years, notwithstanding title V. No permit shall be issued that is inconsistent with the requirements of this title, and title V as applicable.

(b) Compliance Plan.--Each initial permit application shall be accompanied by a compliance plan for

the source to comply with its requirements under this title. Where an affected source consists of more than one affected unit, such plan shall cover all such units, and for purposes of section 502(c), such source shall be considered a "facility". Nothing in this section regarding compliance plans or in title V shall be construed as affecting allowances. Except as provided under subsection (c)(1)(B), submission of a statement by the owner or operator, or the designated representative of the owners and operators, of a unit subject to the emissions limitation requirements of sections 404, 405, and 407, that the unit will meet the applicable emissions limitation requirements of such sections in a timely manner or that, in the case of the emissions limitation requirements of sections 404 and 405, the owners and operators will hold allowances to emit not less than the total annual emissions of the unit, shall be deemed to meet the proposed and approved compliance planning requirements of this section and title V, except that, for any unit that will meet the requirements of this title by means of an alternative method of compliance authorized under section 404(b), (c), (d), or (f) section 407(d) or (e), section 409 and section 410, the proposed and approved compliance plan, permit application and permit shall include, pursuant to regulations promulgated by the Administrator, for each alternative method of compliance a comprehensive description of the schedule and means by which the unit will rely on one or more alternative methods of compliance in the manner and time authorized under this title. Recordation by the Administrator of transfers of allowances shall amend automatically all applicable proposed or approved permit applications, compliance plans and permits. The Administrator may also require--

(1) for a source, a demonstration of attainment of national ambient air quality standards and

(2) from the owner or operator of two or more affected sources, an integrated compliance plan providing an overall plan for achieving compliance at the affected sources.

(c) First Phase Permits.--The Administrator shall issue permits to affected sources under sections 404 and 407.

(1) Permit Application and Compliance Plan.--

(A) Not later than 27 months after the date of the enactment of the Clean Air Act Amendments of 1990, the designated representative of the owners or operators, or the owner and operator, of each affected source under sections 404 and 407 shall submit a permit application and compliance plan for that source in accordance with regulations issued by the Administrator under paragraph (3). The permit application and the compliance plan shall be binding on the owner or operator or the designated representative of owners and operators for purposes of this title and section 402(a), and shall be enforceable in lieu of a permit until a permit is issued by the Administrator for the source.

(B) In the case of a compliance plan for an affected source under sections 404 and 407 for which the owner or operator proposes to meet the requirements of that section by reducing utilization of the unit as compared with its baseline or by shutting down the unit, the owner or operator shall include in the proposed compliance plan a specification of the unit or units that will provide electrical generation to compensate for the reduced output at the affected source, or a demonstration that such reduced utilization will be accomplished through energy conservation or improved unit efficiency. The unit to be used for such compensating generation, which is not otherwise an affected unit under sections 404 and 407, shall be deemed an affected unit under section 404, subject to all of the requirements for such units under this title, except that allowances shall be allocated to such compensating unit in the amount of an annual limitation equal to the product of the unit's baseline multiplied by the lesser of the unit's actual 1985 emissions rate or its allowable 1985 emissions rates,

divided by 2,000.

(2) EPA Action on Compliance Plans.--The Administrator shall review each proposed compliance plan to determine whether it satisfies the requirements of this title, and shall approve or disapprove such plan within 6 months after receipt of a complete submission. If a plan is disapproved, it may be resubmitted for approval with such changes as the Administrator shall require consistent with the requirements of this title and within such period as the Administrator prescribes as part of such disapproval.

(3) Regulations; Issuance of Permits.--Not later than 18 months after the date of the enactment of the Clean Air Act Amendments of 1990, the Administrator shall promulgate regulations, in accordance with title V, to implement a Federal permit program to issue permits for affected sources under this title. Following promulgation, the Administrator shall issue a permit to implement the requirements of section 404 and the allowances provided under section 403 to the owner or operator of each affected source under section 404. Such a permit shall supersede any permit application and compliance plan submitted under paragraph (1).

(4) Fees.--During the years 1995 through 1999 inclusive, no fee shall be required to be paid under section 502(b)(3) or under section 110(a)(2)(L) with respect to emissions from any unit which is an affected unit under section 404.

(d) Second Phase Permits.--

(1) To provide for permits for (A) new electric utility steam generating units required under section 403(e) to have allowances, (B) affected units or sources under section 405, and (C) existing units subject to nitrogen oxide emission reductions under section 407, each State in which one or more such units or sources are located shall submit in accordance with title V, a permit program for approval as provided by that title. Upon approval of such program, for the units or sources subject to such approved program the Administrator shall suspend the issuance of permits as provided in title V.

(2) The owner or operator or the designated representative of each affected source under section 405 shall submit a permit application and compliance plan for that source to the permitting authority, not later than January 1, 1996.

(3) Not later than December 31, 1997, each State with an approved permit program shall issue permits to the owner or operator, or the designated representative of the owners and operators, of affected sources under section 405 that satisfy the requirements of title V and this title and that submitted to such State a permit application and compliance plan pursuant to paragraph (2). In the case of a State without an approved permit program by July 1, 1996, the Administrator shall, not later than January 1, 1998, issue a permit to the owner or operator or the designated representative of each such affected source. In the case of affected sources for which applications and plans are timely received under paragraph (2), the permit application and the compliance plan, including amendments thereto, shall be binding on the owner or operator or the designated representative of the owners or operators and shall be enforceable as a permit for purposes of this title and title V until a permit is issued by the permitting authority for the affected source. The provisions of section 558(c) of title V of the United States Code (relating to renewals) shall apply to permits issued by a permitting authority under this title and title V.

(4) The permit issued in accordance with this subsection for an affected source shall provide that the affected units at the affected source may not emit an annual tonnage of sulfur dioxide in excess of the number of allowances to emit sulfur dioxide the owner or operator or designated representative hold for the unit.

(e) New Units.--The owner or operator of each source that includes a new electric utility steam generating unit shall submit a permit application and compliance plan to the permitting authority not later than 24 months before the later of (1) January 1, 2000, or (2) the date on which the unit commences operation. The permitting authority shall issue a permit to the owner or operator, or the designated representative thereof, of the unit that satisfies the requirements of title V and this title.

(f) Units Subject to Certain Other Limits.--The owner or operator or designated representative thereof, of any unit subject to an emission rate requirement under section 407 shall submit a permit application and compliance plan for such unit to the permitting authority, not later than January 1, 1998. The permitting authority shall issue a permit to the owner or operator that satisfies the requirements of title V and this title, including any appropriate monitoring and reporting requirements.

(g) Amendment of Application and Compliance Plan.--At any time after the submission of an application and compliance plan under this section, the applicant may submit a revised application and compliance plan, in accordance with the requirements of this section. In considering any permit application and compliance plan under this title, the permitting authority shall endure coordination with the applicable electric ratemaking authority, in the case of regulated utilities, and with unregulated public utilities.

(h) Prohibition.--

(1) It shall be unlawful for an owner or operator or designated representative, required to submit a permit application or compliance plan under this title to fail to submit such application or plan in accordance with the deadlines specified in this section or to otherwise fail to comply with regulations implementing this section.

(2) It shall be unlawful for any person to operate any source subject to this title except in compliance with the terms and requirements of a permit application and compliance plan (including amendments thereto) or permit issued by the Administrator or a State with an approved permit program. For purposes of this subsection, compliance, as provided in section 504(f), with a permit issued under title V which complies with this title for sources subject to this title shall be deemed compliance with this subsection as well as section 502(a).

(3) In order to ensure reliability of electric power, nothing in this title or title V shall be construed as requiring termination of operations of an electric utility steam generating unit for failure to have an approved permit or compliance plan, except that any such unit may be subject to the applicable enforcement provisions of section 113.

(i) Multiple Owners.--No permit shall be issued under this section to an affected unit until the designated representative of the owners or operators has filed a certificate of representation with regard to matters under this title, including the holding and distribution of allowances and the proceeds of transactions involving allowances. Where there are multiple holders of a legal or equitable title to, or a leasehold interest in, such a unit, or where a utility or industrial customer purchases power from an affected unit (or units) under life-of-the-unit, firm power contractual

arrangements, the certificate shall state (1) that allowances and the proceeds of transactions involving allowances will be deemed to be held or distributed in proportion to each holder's legal, equitable, leasehold, or contractual reservation or entitlement, or (2) if such multiple holders have expressly provided for a different distribution of allowances by contract, that allowances and the proceeds of transactions involving allowances will be deemed to be held or distributed in accordance with the contract. A passive lessor, or a person who has an equitable interest through such lessor, whose rental payments are not based, either directly or indirectly, upon the revenues or income from the affected unit shall not be deemed to be a holder of a legal, equitable, leasehold, or contractual interest for the purpose of holding or distributing allowances as provided in this subsection, during either the term of such leasehold or thereafter, unless expressly provided for in the leasehold agreement. Except as otherwise provided in this subsection, where all legal or equitable title to or interest in an affected unit is held by a single person, the certification shall state that all allowances received by the unit are deemed to be held for that person.

An Interim Evaluation of Sulfur Dioxide Emissions Trading

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[Preliminary Draft of June 14, 1997]

Title IV of the 1990 Clean Air Act Amendments established the first large-scale, long-term environmental program to rely on tradable emissions permits (called “allowances” in this program) to control pollution.¹ This program was designed to cut acid rain by reducing sulfur dioxide (SO₂) emissions from electric generating plants to about half their 1980 level. It is of interest both as a response to an important environmental issue and as a landmark experiment in environmental policy. This experiment comes at a particularly important time, since emission trading is under serious consideration (with strong U.S. backing) for use to deal with global climate change by curbing emissions of carbon dioxide (CO₂). The economic stakes in climate change surpass those in acid rain by several orders of magnitude.²

In this article we summarize the results to date of our ongoing empirical analysis of compliance costs and allowance market performance under the US acid rain program. Our work is based primarily on data at the generating unit level for 1995, the first year this program constrained emissions, and earlier years.³ Supporting analysis and additional detail are presented, and other issues are explored, in Ellerman, et al (1997) and our other papers that are cited in what follows.

What is the Acid Rain Program?

Acid rain (or, more properly, acid deposition) occurs when SO₂ and nitrogen oxides (NO_x) react in the atmosphere to form sulfuric and nitric acids, respectively. These acids then fall to earth, sometimes hundreds of miles from their source, in either wet or dry form. The dominant precursor of acid rain in the United States is SO₂ from coal-fired power plants in the Northeast and Midwest. These emissions are the focus of the acid rain program created by Title IV of the Clean Air Act Amendments of 1990.

Title IV creates a cap on utility SO₂ emissions from electric generating units, to be implemented in two phases. During Phase I (1995 through 1999), aggregate annual emissions from the 263 dirtiest large generating units (the so-called "Table A units") must be below a fixed cap. Two provisions, little noted when Title IV was debated, provide that other units can be voluntarily brought under Title IV regulation in Phase I. The idea was to enable owners of Table A units to substitute emission reductions from other units for reductions from Table A units.⁴ In Phase II (2000 and beyond), virtually all fossil-fueled electric generating units in the continental US become subject to a tighter cap on aggregate annual emissions.

In both Phases, owners of affected generating units (i.e., those subject to SO₂ emissions limits under Title IV) are given fixed numbers of tradable permits, called "allowances," each year. Each allowance enables its holder to emit one ton of SO₂ legally. An allowance can be used in the year of issue or "banked" for use in any subsequent year. A small number of additional allowances are auctioned annually by the US Environmental Protection Agency (EPA), with the revenues rebated to utilities in proportion to their allowance allocations. Each generating unit must deliver to EPA valid allowances sufficient to cover each year's emissions

within 30 days of year's end or incur serious penalties. (Emissions are continuously monitored from affected units, at an average annual cost of about \$124,000 per unit.) Allowances can be bought or sold without restriction to cover emissions anywhere in the continental US, and they can be held for use in any future year.⁵ In the early 1990s, analysts predicted allowance prices of \$250-350 in Phase I and \$500-700 in Phase II.⁶

The acid rain program represents a conceptually important departure from the "command and control" tradition that has dominated environmental policy in the US and abroad. This traditional approach involved prescription of either particular abatement methods (so-called engineering standards) or maximum emission *rates* (so-called performance standards) for a particular pollutant for classes (commonly, vintages) of emissions sources. In 1971, for instance, the EPA set maximum SO₂ emission rates (measured as pounds of sulfur emitted per million Btu of fuel burned) for new coal-fired power plants, but it imposed no limits on old plants or on total emissions. The tradable permit approach, in contrast, deals with a quantity more directly linked to damages: total emissions from all regulated sources.

One important reason why Congress adopted this non-traditional approach in Title IV was that there seemed to be no workable "command and control" solution to the acid rain problem.⁷ Because new generating units had historically been subject to stricter environmental controls than old units, utilities had faced strong incentives to extend the lives of their old units. By 1985, 83 percent of power plant SO₂ emissions came from units not meeting the 1971 SO₂ emission rate standard for new units.⁸

The designs and site characteristics of these old units varied enormously, and, as a consequence, so did the costs of reducing their SO₂ emissions. Holding power generation constant, there are two basic ways to reduce SO₂ emissions from electric generating units: burn

fuel with less sulfur (“switching”) or retrofit and operate flue gas desulfurization facilities (“scrubbing”). Switching to coal with a lower sulfur content typically involves little or no capital cost, while scrubbers involve substantial capital costs. (Our data imply capital costs of about \$125 million on average for a 500 MW generating unit.) Because of differences in location and design, generating units differ in the ease with which they can switch to low-sulfur fuel. Similarly, some units are located on sites that can easily accommodate scrubbers, while others are not. Any environmental program that imposed the same standards across this heterogeneous population would likely impose very high and politically unacceptable costs on some utilities or regions.

Allowances were given to utilities rather than sold because there was simply no way a sales-based program could have passed Congress. Indeed, the politically live alternative to a simple grant of allowances was the addition of an electricity tax that would have forced “clean” utilities’ customers to help pay “dirty” utilities’ cleanup costs. The complex statutory provisions that allocate allowances to individual generating units show clear evidence of rent-seeking but do not provide strong support for any simple political-economic model of government decision-making.⁹ On the whole, the interests that had successfully resisted acid rain legislation during the 1980s – states that produced and/or burned high-sulfur coal – did less well in the allowance allocation process than their earlier success on this issue would have suggested.

What Happened to Sulfur Dioxide Emissions?

Figure 1 shows the basic pattern of aggregate emissions from Phase I units through 1995. Aggregate SO₂ emissions declined substantially from 1990 through 1994, even though

the EPA had forecast an increase over this period. Our analysis shows that about 80 percent of this pre-Phase I emission decline reflected the expansion of the market area served by low-sulfur coal from the Powder River Basin (PRB) in northeast Wyoming.¹⁰ This expansion was driven mainly by declining rail rates, reflecting the continuing productivity benefits of rail deregulation and the introduction of competition into the haulage of coal from the PRB.

Figure 1 also shows that emissions dropped sharply in 1995 to about 5.3 million tons, 40 percent below the aggregate limit of 8.7 million tons.¹¹ The 3.4 million allowances not needed to cover 1995 emissions were banked for future use. There are two plausible explanations for this dramatic over-compliance.

The first explanation involves intertemporal trading and optimization. Allowances have generally been expected to be more expensive in Phase II than in Phase I, so that even when the Phase I constraint is not binding it may be rational to reduce emissions on the margin and save the allowances thus freed up for use in Phase II, enabling aggregate emissions to exceed the Phase II cap for a time. This point was widely discussed in the early 1990s, and many analysts argued that some banking of this sort would be efficient throughout Phase I.

It is easy to show that if in a riskless world it is efficient to carry allowances from any period t to period $t+1$, the allowance price must rise at the rate of interest between those periods. In addition, the allowance price must equal operating units' short-run marginal abatement cost, with the obvious inequalities for units reducing emissions by either zero or the maximum possible in the short run. Thus if marginal costs of abatement are non-decreasing, emissions from regulated units must fall along an efficient path with banking from period t to period $t+1$.

At some time T^* in Phase II, the "allowance bank" will be exhausted, and thereafter the allowance price must equal marginal compliance cost. In a riskless world arbitrage would then ensure that the allowance price at any time t before T^* would equal the marginal cost of compliance at T^* , discounted back to t . In the real, risky world, of course, neither T^* nor marginal cost at that time are known for certain, and there is a time-varying "convenience yield" associated with holding allowances, as with holding other commodities.¹² The convenience yield will raise Phase I allowance prices, reduce the rate of allowance price increase during a period of banking, and contribute to price variability.

The second explanation for substantial over-compliance in 1995 is that in aggregate the market under-estimated the penetration of PRB coal driven by declines in rail rates and, as a consequence, over-invested in scrubbers and signed too many long-term contracts for low-sulfur coal. This disequilibrium explanation is consistent with the fact that the actual level of banking in 1995 far exceeded earlier predictions and with other evidence discussed below.

While only the 263 generating units listed in the law, the so-called "Table A units", were required to be regulated in Phase I, Figure 1 also reflects data from an additional 182 electric generating units that "volunteered" for such regulation. This was almost 30 percent of the units eligible to volunteer, far in excess of expectations.¹³

As noted above, the provisions under which these units opted into Phase I was designed to allow substitution of lower-cost abatement at non-Table A units for higher cost abatement at Table A units. However, while some cost-reducing substitution did occur, and we estimate that the volunteers reduced their emissions in aggregate by between 140,000 and 214,000 tons, our analysis indicates that factors other than abatement cost differences had more impact on the decision to volunteer a unit for Phase I regulation.¹⁴ The process of allocating allowances to

volunteers based on simple rules inevitably involved error (in this case litigation was also involved), and we estimate that these “substitution and compensation” units received in aggregate between 243,000 and 336,000 more allowances (18 to 25 percent of their total allocation) than they would have needed to cover their emissions in the absence of Title IV. In addition, volunteers were exempted from certain NO_x regulations that would have been very costly for some units. In short, utilities’ substantial use of the “substitution and compensation” provisions increased both their profits and their emissions somewhat but did little to reduce compliance costs.

How Were Emissions Reduced?

In order to analyze the emissions reduction in 1995 attributable to Title IV, it is necessary to estimate what SO₂ emissions would have been for Phase I units in that year in the absence of Title IV. Our rough estimate of each Phase I unit’s 1995 counterfactual emissions is the product of its 1993 emissions rate, SO₂ emitted per unit of heat input, times its actual 1995 heat input.¹⁵ Figure 1 shows that total 1995 counterfactual emissions for Phase I units, indicated by the asterisk, were slightly above actual 1993 emissions, reflecting a 8.6 percent increase in aggregate heat input for Phase I affected units between 1993 and 1995. As the increase in heat input was 8.3 percent for all US electric generating units, it is clear that compliance was *not* achieved by reducing utilization of units subject to Phase I regulation. Counterfactual emissions were 0.5 million tons above the Phase I cap and 3.9 million tons above actual 1995 emissions. One-quarter of the total 1995 reduction from the counterfactual occurred in Ohio, and 90 percent occurred in the nine high-emissions states extending from Pennsylvania and West Virginia west to Missouri and south to Tennessee and Georgia.

Comparing actual and counterfactual emissions for each unit, we find that the 26 Table A units that installed scrubbers accounted for 45 percent of the total reduction in emissions. Two thirds of the reduction due to scrubbing was contributed by seven units at three large plants. Fuel switching, almost entirely to lower-sulfur coal (rather than, say, to natural gas), accounted for 55 percent of total reductions. While switching to PRB coal accounted for a large fraction of the reductions in emissions between 1990 and 1993, it only accounted for about 13 percent of the difference between actual and counterfactual 1995 emissions at Phase I units. (This was 24 percent of the difference accounted for by fuel switching.) Switching to lower-sulfur (not necessarily low-sulfur) eastern or midwestern coal was much more important. Finally, even though the "substitution and compensation" provisions were much more heavily used than had been anticipated, Table A units accounted for at least 95 percent of 1995 emission reductions. As noted above, abatement cost differences played a minor role in utilities' decisions to volunteer generating units for regulation.

One can learn about the extent to which compliance strategies took advantage of the flexibility allowed by Title IV by comparing units' actual emission rates with what those rates would plausibly have been in the absence of emissions trading. Figure 2 provides such a comparison, using as each unit's counterfactual emissions rate the smaller of its 1993 rate and the ratio of the 1995 allowances it received to its 1995 heat input. This ratio is the emissions rate the unit would need to have attained in order to be in compliance with neither a shortage nor a surplus of allowances. Emission rate data on Phase I affected units are displayed in Figure 2, with units arrayed in order of increasing counterfactual emission rate. The counterfactual rate is indicated by the ascending curve, and the thin vertical bars show each unit's actual 1995 emission rate. While there is some tendency for units with higher

counterfactual emission rates to have higher actual emission rates, the correlation is far from perfect. And that is precisely the point.

Some units reduced emissions in 1995 much more than they absolutely had to and either transferred allowances to other units or held them for future use, while others acquired allowances in order to be in compliance. About one-third of vintage 1995 allowances were banked for future use. On the other hand, about 10 percent of 1995 total emissions (534,000 tons) were covered by allowances acquired or transferred from other units. Emissions exceeded allowance allocations at 98 generating units located in 18 of the 24 states with Phase I units. The heterogeneity of unit-specific response strategies depicted in Figure 2 indicates that Title IV was an economically significant departure, as well as a conceptually significant departure, from the traditional “one size fits all” US approach of setting uniform unit-level emission rate standards.

What Happened in Allowance Markets?

Figure 3 displays historical information on the pricing of current vintage allowances.¹⁶ These data come from three sources: trade press reports, price indices from three private market-making organizations, and the EPA’s annual March auctions. As directed by the statute, the EPA has implemented a discriminatory auction scheme, in which winning bidders pay what they bid. The circles in Figure 3 shows the clearing prices (lowest winning bids) for current vintage allowances.

The first allowance transactions were reported in the trade press in mid-1992 at prices of \$300 and \$265 per allowance – roughly in line with expectations. In January 1993, the EPA promulgated the main regulations governing implementation of Title IV, including all the

regulations governing allowance trading. The March 1993 auction results, which included a clearing price of \$131 for vintage 1995 allowances, were dismissed as an aberration or a reflection of defects in the auctions' design. For the remainder of 1993, the few private transactions reported and the Emissions Exchange allowance price index (EX in Figure 3) seemed to support this view, though they pointed to prices in the \$150-200 range rather than the \$250-300 range. EPA's second auction, in March 1994, cleared at \$150 for vintage 1995 allowances, still noticeably below the EX price. Soon thereafter, however, the EX price fell to match the auction price, and the EX series was validated by price series published by Fieldston (EATX) and Cantor Fitzgerald (CF), two other market-makers. The March auction results in 1995, 1996, and 1997 are virtually identical to the contemporaneous private market prices reflected in these three series.

The March 1993 auction was a much better predictor of prices during 1995 than roughly contemporaneous transactions in the emerging (but still thin) private market. Some contemporary critics suggested that prices in that first auction were biased downward, but, with the benefit of hindsight, it appears more likely that prices outside the auction had been inflated by earlier projections of high Phase I allowance prices. The early auctions suggested, correctly as it turned out, that those projections were too high.

Figures on trading volume also suggest the emergence of an efficient allowance market, obeying the law of one price, around the middle of 1994. We estimate that 130,000 allowances had been traded on the private market by the end of March 1993, and an additional 226,000 traded in the April 1993 – March 1994 period.¹⁷ Private market volumes for the next three April – March years were sharply higher: 1.6 million, 4.9 million, and 5.1 million allowances,

respectively. (In contrast, volume in the annual EPA auction has never exceeded 300,000 allowances.)

There is no obvious standard against which to evaluate these volumes, of course. If Congress had allocated allowances perfectly so that setting emissions equal to allocations at each unit would serve to equate marginal costs, Title IV could have produced cost minimization with no trades at all. The point here is simply that the *increase* in trading volume after mid-1994, a factor of almost 20 in two years, was substantial by any standard. It is also worth noting that this increase could not have occurred if the EPA had not implemented Title IV with the intent and effect of keeping transactions costs low – another departure from tradition.

Data from the EPA auctions add a final bit of support to the view that an efficient allowance market emerged as the Phase I compliance date approached. In the two auctions held in March 1993, average winning bids were 11.5 and 20.6 percent above the lowest winning bids, and many bids (offers to sell) were submitted at prices well below (above) this range. In the three auctions held in March 1994, however, the differences between average and marginal winning bids were between 5.7 and 6.4 percent. In the nine subsequent auctions through March 1997, no such difference exceeded 3.4 percent, and all but two were below 2.4 percent. These data are at least consistent with strong constraints on bidding being imposed by a well-developed private market that became established during 1994.¹⁸

When the 1990 CAAA was under consideration, opponents of the tradable allowance approach argued that a private market would not develop for SO₂ emissions from the heavily regulated electric power industry. They contended that publicity-shy utilities would be reluctant to buy “licenses to pollute” and that the state public utility commissions (PUCs) that regulated electric utilities would discourage the interstate trading necessary for the development

of an efficient allowance market.¹⁹ On the surface it is consistent with these fears that as of January 1996 only 15 state PUCs had explicitly addressed the regulatory treatment of allowance transfers by generic order or informal guideline. Interstate trading does not seem to have been deterred, however. By January 1996 allowances had been transferred across the borders of all 24 states with Phase I affected units and of 10 of the 23 states with only Phase II units.²⁰ Interviews with staff of all PUCs that had not addressed this issue indicate that the main reason guidance had not been issued was that no request for it had been received.

How Much Did It Cost?

Even though 445 electric generating units were subject to Phase I aggregate emissions limits in 1995, 132 units actually increased emissions relative to the counterfactual. These generally small increases were approximately balanced by small reductions made at a roughly equal number of other units. All the SO₂ emissions reductions in 1995 can thus be attributed to about 180 units in 70 plants. Because fuel data are available only at the plant level, our detailed analysis of compliance strategies and costs focused on the 206 Phase I units in those plants.

We find the total (annualized) cost of reducing emissions by 3.9 million tons (relative to the counterfactual) in 1995 to have been about \$726 million. This is \$210 per ton of emissions reductions involving positive cost and about \$187 per ton if emissions reduced at no cost (through switches to PRB coal) are included in the total. These per-ton abatement cost figures are at the low end of the range of earlier estimates, which varied from \$180 to \$307 per ton of emissions reduction for reductions between 3.1 and 4.4 million tons. We estimate emissions reduction through switching to have cost \$153 per ton on average, while scrubbing cost \$265 per ton on average. There was considerable variation around both these averages. Thus some

scrubbers may have been economic, while construction of others may have been driven mainly by incentives for scrubbing that were built into Title IV at the urging of legislators from states producing high-sulfur coal, political pressures on utilities in those states to scrub rather than switch away from in-state coal, and pressures from pro-scrubber environmentalists in some other states.

The observed per-ton cost of scrubbing in 1995 is substantially below earlier estimates. Our investigation indicates that this difference reflects unanticipated improvements in instrumentation and controls that reduce personnel requirements, innovative sludge removal techniques, and higher than expected utilization of scrubbed units (which reduces capital cost per ton of sulfur removed).

As Figure 2 suggests, there is no shortage of anecdotal evidence that utilities have made good use of the flexibility provided by Title IV, and it is natural to ask how much money this has saved. However, while there is a large literature comparing ideal market-based policies with actual command-and-control regimes,²¹ it is unclear what sort of command-and-control policy could most instructively be compared with actual performance under Title IV. We have estimated that Title IV saved on the order of 25-34 percent as compared to a regime with the same allocation of allowances to generating units but no ability to transfer allowances from one generating unit to another by trading or intra-company reallocation. This is a substantial dollar saving (on the order of \$225-375 million per year) but lower in percentage terms than most savings estimates in the literature just mentioned. Perhaps this is because, as we next discuss, Title IV did not produce an outcome in which long-run total cost was minimized.

Why Have Allowance Prices Been So Low?

As we noted earlier, much of the story in allowances markets through 1995 was the dawning realization that allowance prices for that year were going to be only around \$100, well under half of what had been expected at the start of the decade. The discussion just above rules out two explanations for this discrepancy.

On the one hand, opponents of the tradable emissions approach commonly attribute low allowance prices to some defect in allowance markets. As a matter of theory it is unclear why unspecified market defects should push prices down, and as a matter of fact our investigation reveals no significant sources of downward bias in prices. On the other hand, some supporters of this approach would be gratified if the difference between actual and expected allowance prices mainly reflected unanticipated innovations that greatly reduced compliance costs. While there was clearly some induced innovation,²² however, and average compliance cost per ton of emission reduction was at the low end of the range of earlier estimates, the difference between actual and expected compliance cost per ton is simply too small to account for the dramatic gap between actual and expected allowance prices.

There are three keys to explaining this gap. The first is that the current vintage allowance price at any point in time must equal short-run marginal abatement costs but can be below long-run marginal and/or average total costs. As noted above, during a period of allowance banking the spot allowance price must also equal the discounted value of expected post-banking long-run marginal compliance cost, plus the convenience yield of holding allowances. The second key point is that market participants seem to have substantially

underestimated the market penetration of low-sulfur PRB coal driven by rail rate declines after 1990 and its effect on premia for low-sulfur coal produced in the East and Midwest.

The third key point is that compliance decisions generally had to be made well before the start of 1995. In particular, decisions to build scrubbers required commitments in 1992-93, when information about allowances prices was highly imperfect. Most of the respondents to the MIT survey who had elected to scrub indicated that expectations of allowance prices in the \$300-400 range were "very important" in the choice of scrubbing. Other respondents identified substantial capacity for which they had reversed an initial decision to scrub; a third of these pointed to "low allowance prices" as a reason for reversal, and two-thirds pointed to a fall in low sulfur coal prices relative to scrubber costs. Though switching does not require as much advance planning as scrubbing, many utilities signed long-term contracts for low sulfur coal in the 1992-94 period at prices reflecting prevailing or expected premia for such coal.

The picture that emerges is one in which market participants underestimated the SO₂ emissions reductions that would be produced at zero or negative cost by switching to PRB coal and thus, until mid-1994 or so (see Figure 3) over-estimated allowance prices during at least the early part of Phase I. As a result, there was over-investment in scrubbers, and too many long-term contracts for low-sulfur coal were signed – some at very high prices. Once a scrubber is built, however, the decision to operate it or not turns on a comparison between the short-run marginal operating cost of using the scrubber to reduce emissions of sulfur by a ton, roughly \$65 per ton on average,²³ and the cost of the allowance that would need to be purchased if the scrubber were not run. Because of over-investment in compliance, the short-run marginal cost of abatement curve, which determines the relation between allowance prices and abatement volumes, was well below the long-run marginal cost curve during 1995. A short-run marginal

cost of abatement curve that is lower than it would be in long-run equilibrium is consistent with both unexpectedly low allowance prices in the short run and unexpectedly high allowance banking.²⁴

Three additional bits of evidence support this disequilibrium explanation. First, it was generally expected that the difference between the spot market prices of low- and high-sulfur coal in regions producing both types, the so-called sulfur premium, would rise because of the onset of Phase I. Nonetheless, the sulfur premium dropped by half in Central Appalachia at the start of 1995, making it consistent with an allowance price of about \$130, near the price range observed at that time. Second, even though total heat input to all electricity fossil-fueled generating units rose by 8.3 percent between 1993 and 1995, heat input rose by only 5.5 percent at Phase I units that had switched fuels. This is consistent with attempts to reduce utilization of units that had signed long-term contracts for low-sulfur coal at above-market prices. Finally, as noted above, along an efficient intertemporal emissions path with banking in Phase I, one would expect allowance prices to rise and, with non-decreasing marginal abatement cost, unit-specific emissions to be non-increasing. Nonetheless, emissions from Table A units appear to have increased by about 7 percent in 1996, consistent with attempts to move toward an efficient time-path of emissions but not with movement along such a time-path.

What Have We Learned?

Economists have argued for decades that, where it can be used, the tradable permit approach is superior in theory to command-and-control environmental regulation.²⁵ The US acid rain program appears to prove this argument correct in practice. Not only did Title IV more than achieve the SO₂ emissions goal established for Phase I, it did so on time, without

extensive litigation, and at costs lower than had been projected. Even though some of the credit for all this must be attributed to increases in the use of low-sulfur PRB coal driven by declines in rail rates, it is important to note that few, if any, command-and-control environmental programs have ever succeeded on all these dimensions.

Viewing the acid rain program as a more general experiment in environmental policy, it is too early to claim that we have learned all the lessons it will eventually teach us. While we have observed the creation of workable allowance markets over a period of several years, we have only completed analysis of one year's data on compliance strategies and costs. Still, we believe several important lessons follow from our experience to date with Title IV.

First, we have learned that large-scale tradable permit programs can work roughly as the textbooks describe. That is, they can both guarantee emissions reductions and allow profit-seeking emitters to reduce total compliance cost. Some environmentalists seem to have learned this lesson too well and have come to regard the tradable permit approach as a magic tool that can solve any environmental problem, including global climate change, at negligible cost. Our analysis does not support such a view, however. It suggests that, like other real markets, tradable permit programs cannot be expected to achieve textbook perfection or guaranteed to produce breakthrough innovations.²⁶

Second, one can expect a tradable permit program both to produce surprises and to adapt reasonably efficiently to surprises produced elsewhere in the economy. The more flexibility an environmental program allows, the more surprises clever behavior will produce. The ceiling on total emissions in a tradable emissions program eliminates (or at least minimizes) the environmental harm such cleverness can cause. On the other hand, any long-lived policy must adapt to surprise events: the big surprise here was the rapid expansion of the

market area of Powder River Basin coal. The Title IV program did not adapt perfectly to this surprise, since delayed recognition of its extent apparently led to over-investment and excess abatement. But the market did react to the information contained in allowance prices, and orders for scrubbers were canceled. The banking provision then ensured that emissions reductions that were cheap ex post were made, even though they were not required by the statute. It is hard to imagine any command-and-control regime adapting as sensibly to such an important exogenous event, particularly since such programs generally lack any incentives for information production or dissemination.

Third, efficient, competitive markets for tradable allowances can develop, though the speed of development may be sensitive to some elements of program design. In particular, the allowance auctions that the EPA was required to conduct have facilitated both the price discovery process and the development of the allowance market. Larger, better-designed auctions might have done better, or perhaps the allowance market could not have emerged before compliance became a near-term issue no matter how the auctions were structured. Only experience with other new programs will help to resolve this point.

When we discuss among ourselves how to present the lessons of Title IV, we use the metaphor of a glass that is both half full and half empty. The Title IV experience to date has demonstrated that the tradable permit approach is a very valuable policy tool that has proven itself superior to traditional methods for dealing with acid rain. On the other hand, real markets do not perform with the frictionless perfection of those in textbooks, particularly when they must guide long-lived investments made under uncertainty. The tradable permit approach is not a panacea or even necessarily the best approach to most environmental problems.

References

Atkeson, Erica, "Joint Implementation: Lessons from Title IV's Voluntary Compliance Programs," Working Paper 97-003, MIT Center for Energy and Environmental Policy Research, May 1997.

Bailey, Elizabeth M., "Allowance Trading Activity and State Regulatory Rulings: Evidence from the US Acid Rain Program," Working Paper 96-002, MIT Center for Energy and Environmental Policy Research, March 1996.

Cason, T.N., "Seller Incentive Properties of EPA's Emissions Trading Auction," Journal of Environmental Economics and Management, September 1993, 25, 177-195.

Cason, T.N., "An Experimental Investigation of the Seller Incentives in EPA's Emissions Trading Auction," American Economic Review, September 1995, 85, 905-922.

Cason, T.N., and Charles R. Plott, "EPA's New Emissions Trading Mechanism: A Laboratory Evaluation," Journal of Environmental Economics and Management, March 1996, 30, 133-160.

Ellerman, A. Denny, and Juan Pablo Montero, "Why Are Allowance Prices So Low? An Analysis of the SO₂ Emissions Trading Program," Working Paper 96-001, MIT Center for Energy and Environmental Policy Research, February 1996.

Ellerman, A. Denny, Richard Schmalensee, Paul L. Joskow, Juan Pablo Montero, and Elizabeth M. Bailey, Sulfur Dioxide Emissions Trading Under Title IV of the 1990 Clean Air Act Amendments, MIT Center for Energy and Environmental Policy Research, July 1997.

Hahn, Robert W., and Gordon L. Hester, "Marketable Permits: Lessons for Theory and Practice," Ecology Law Quarterly, 1989a, 16, 361-406.

Hahn, Robert W., and Gordon L. Hester, "Where Did All the Markets Go?" Yale Journal on Regulation, Winter 1989b, 6, 109-153.

Intergovernmental Panel on Climate Change (IPCC), Climate Change 1995. Economic and Social Dimensions of Climate Change: Contribution of Working Group III to the Second Assessment Report of the Intergovernmental Panel on Climate Change, J. Bruce, H.P. Lee, and E.F. Haites, eds., Cambridge: Cambridge University Press, 1996.

Joskow, Paul L., and Richard Schmalensee, "The Political Economy of Market-Based Environmental Policy: The U.S. Acid Rain Program," Journal of Law and Economics, forthcoming.

Joskow, Paul L., Richard Schmalensee, and Elizabeth M. Bailey, "The Market for Sulfur Dioxide Emissions," unpublished manuscript, Department of Economics, MIT, February 1997.

Montero, Juan Pablo, "Volunteering for Market-Based Environmental Regulation: The Substitution Provision of the SO₂ Emissions Trading Program," Working Paper 97-001, MIT Center for Energy and Environmental Policy Research, January 1997.

Oates, Wallace E., Paul R. Portney, and Albert M. McGartland, "The *Net* Benefits of Incentive-Based Regulation: A Case Study of Environmental Standard Setting," American Economic Review, December 1989, 79, 1233-1242.

National Economic Research Associates, Key Issues in the Design of NO_x Emission Trading Programs to Reduce Ground-Level Ozone, Palo Alto: Electric Power Research Institute, EPRI TR-104245, July 1994.

Pechan, E.H., The Acid Rain Data Base Version 1 (ARDBV1), E.H. Pechan Associates Inc., Contract no. 68-D3-0005, prepared for the US Environmental Protection Agency's Office of Atmospheric Programs, Acid Rain Division: Washington, DC, 1995.

Schmalensee, Richard "Greenhouse Policy Architectures and Institutions," MIT Joint Program on the Science and Policy of Climate Change, Report No. 13, November 1996.

Stavins, Robert N., "Unknown Title," Journal of Economic Perspectives, this issue.

Tietenberg, Thomas H., Emissions Trading: An Exercise in Reforming Pollution Policy, Washington: Resources for the Future, 1985.

Tietenberg, Thomas H., Environmental and Natural Resource Economics, 3rd Ed., New York: HarperCollins, 1992.

U.S. Environmental Protection Agency (EPA), 1995 Compliance Results: Acid Rain Program, project # EPA/430-R-96-012, Washington, DC, EPA, July 1996.

Williams, Jeffrey C., and Brian D. Wright, Storage and Commodity Markets, Cambridge, UK: Cambridge University Press, 1991.

Notes

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Footnotes:

¹ For discussions of earlier US experience with emissions trading, see Hahn and Hester (1989a, 1989b) and National Economic Research Associates (1994, ch. 2). There is very little experience with this approach outside the US.

² See generally IPCC (1996).

³ As the term is used here, an electric generating *unit* is a combustion device (boiler or turbine) used to power one or more electric generators. A typical generating *plant* houses several generating units, which may be of different vintages, scales, or types. Our work relies heavily on the EPA's National Allowance Data Base (NADB), Supplemental Data File (SDF), Allowance Tracking System (ATS), and Emissions Tracking System (ETS). In addition, we have relied on the trade press, earlier studies of compliance by the Electric Power Research Institute (EPRI), a mail survey of affected utilities (replies covered 37% of affected capacity in Phase I), and many telephone interviews with personnel from government agencies, electric utilities, and participants in allowance markets.

⁴ It was not intended that owners of Table A units be able to meet their emission reduction obligations in Phase I simply by reducing generation from those units. If generation at a Table A unit were reduced significantly, one or more non-Table A units had to be brought under Phase I regulation to compensate, and increased generation at those units had to offset the reduction at the Table A unit. Since generation at Table A units increased substantially in 1995, this provision was not of much importance.

⁵ Permitting allowances to be traded freely anywhere in the US would be a first-best policy if and only if emissions everywhere in the US had the same marginal damages, but they plainly do not. Unrestricted trading would be a reasonable second-best response to worries that the allowance market

would otherwise be too thin, however, if marginal abatement costs are inversely correlated with marginal damages. In this case emissions reductions will tend to be made in the "right" places in equilibrium. It seems likely that this condition is satisfied in this case, though we have seen no formal analysis.

⁶ Most published reports failed to point out that arbitrage conditions rule out a predictable upward jump in allowance prices at the start of Phase II.

⁷ The origins and political economy of this program are discussed in more detail in Joskow and Schmalensee (forthcoming) and in Stavins (this issue).

⁸ Calculated by the authors from EPA's National Allowance Data Base.

⁹ Joskow and Schmalensee (forthcoming) analyze these rules in detail.

¹⁰ See Ellerman and Montero (1996)

¹¹ In no state did Phase I affected units produce emissions in excess of the allowances they were issued.

¹² See, e.g., Williams and Wright (1991).

¹³ In contrast, a much-discussed provision aimed at inducing non-utility sources of SO₂ emissions to "opt-in" to the acid rain program had produced only two volunteers by March 1997. See Atkeson (1997) for a discussion.

¹⁴ This paragraph is based primarily on Montero (1997); alternative estimates are from Ellerman et al (1997). The assertion that opt-ins by electric utility generating units were primarily driven by factors other than abatement cost differences is supported by the fact that over half the units that volunteered for Phase I regulation in 1995 opted out of Phase I for 1996, while other units volunteered for the first time in 1996. [correct??]

15 The ratio of 1995 heat input to 1993 heat input varied relatively little across Phase I units but did tend to be higher than average for scrubbed units. This pattern casts some doubt on the implicit assumption that 1995 heat inputs were not affected by Title IV. We considered an alternative counterfactual that avoids this problem (using heat inputs proportional to 1993 inputs and scaled up to match the 1995 total) and obtained results qualitatively similar to those reported in the text.

16 That is allowances that can be used to offset current emissions: vintage 1995 allowances in 1995, vintage 1995 or 1996 allowances in 1996, and so on. This section is based on Joskow, Schmalensee, and Bailey (1997).

17 EPA's Allowance Tracking System (ATS) was used to identify all transfers of allowances between accounts recorded in the periods indicated. To obtain the trading volume figures in this paragraph, we excluded intra-utility transfers (including intra-holding-company transfers). Our estimates understate private market activity by excluding unrecorded allowance transfers, unexercised options, and trading in allowance futures, all of which seem to have risen over time, particularly during and after 1995.

18 Joskow, Schmalensee, and Bailey (1997) discuss the criticisms of the design of this auction that have been advanced by Cason (1993, 1995), and Cason and Plott (1996). Two points are particularly important. First, the critics model the EPA auction as involving purely private values, thus completely ignoring the robust private market that has served since around mid-1994 to provide a common value for allowances. Second, the critics' main theoretical argument is that utilities that voluntarily offer to sell allowances on the EPA auctions have incentives to understate their reservation prices. In fact, most offers to sell have involved reservation prices well above market-clearing levels, and only a trivial number of voluntarily-offered allowances have been sold on the EPA auctions.

19 This paragraph is based on Bailey (1996).

20 Alaska and Hawaii are exempt from this program, and Idaho has no fossil-fuel electricity generation.

21 See Oates, Portney and McGartland (1989), and Tietenberg (1985, ch. 3; 1992, p. 403).

22 In addition to the advances in scrubber technology noted above, it should be mentioned that the penetration of PRB coal would not have been as great had ways not been found to adapt midwestern boilers to blends of local (bituminous) and PRB (sub-bituminous) coals. Such adaptation was under way prior to 1990, but it may well have been accelerated by the passage of Title IV.

23 There is considerable variation around this figure. Short-run marginal abatement costs of unscrubbed units are determined by the relative prices and availabilities of coals with different sulfur content and by contractual terms that may limit flexibility.

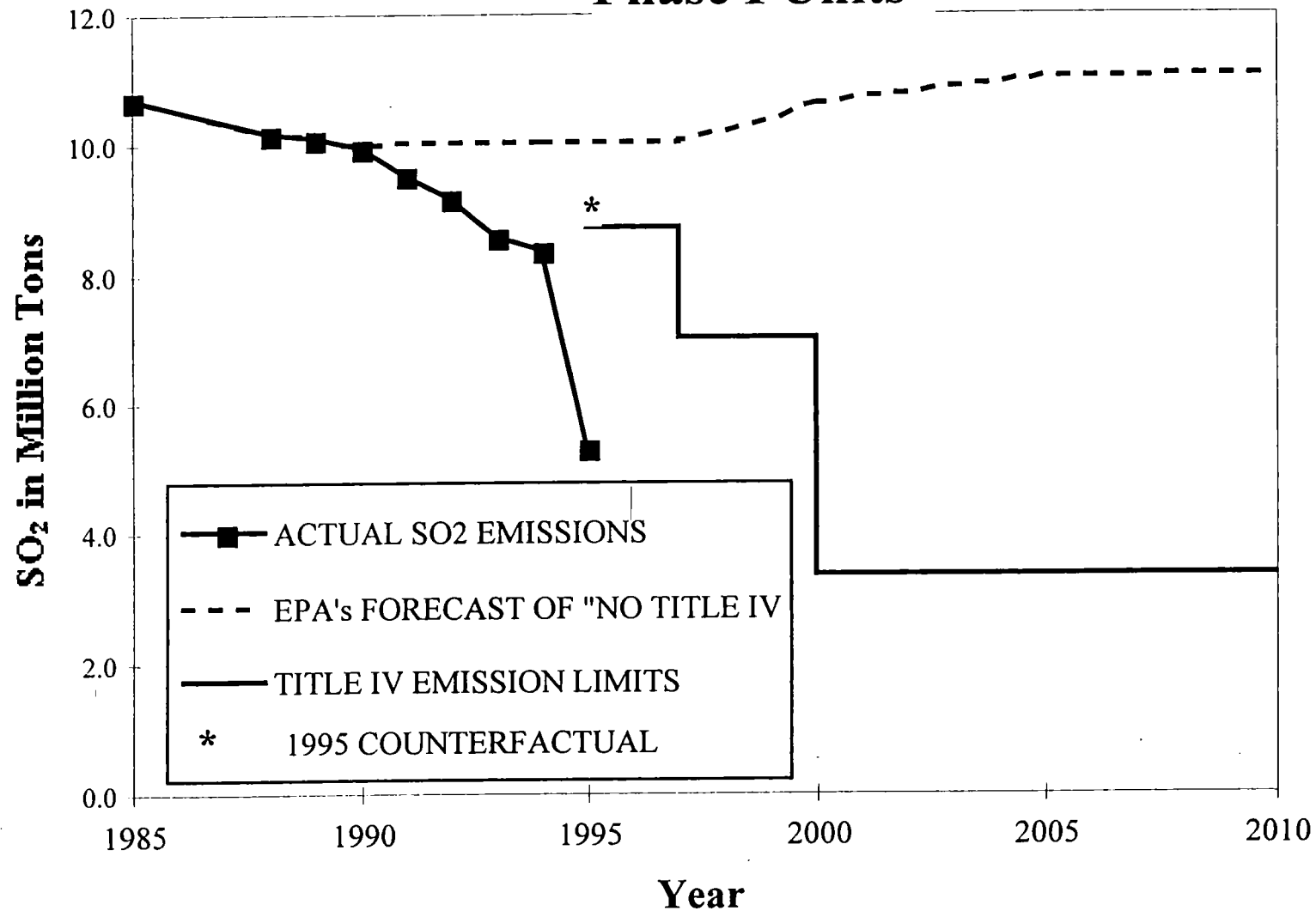
24 This pattern is at least qualitatively consistent with intertemporal equilibrium as well: more banking today postpones the date at which the bank is exhausted (T^* above) and thus reduces the present value of expected marginal abatement cost at that date.

25 See, generally, Tietenberg (1985). One could not use a tradable permit approach of the sort described here, for instance, to deal with an isolated source of toxic emissions with only local effects.

26 There are a variety of reasons why one must be particularly careful about attempting to make inferences from experience with Title IV about the value of the tradable permit approach in the climate change context; these include issues of monitoring and enforcement. See, for instance, Schmalensee (1996).

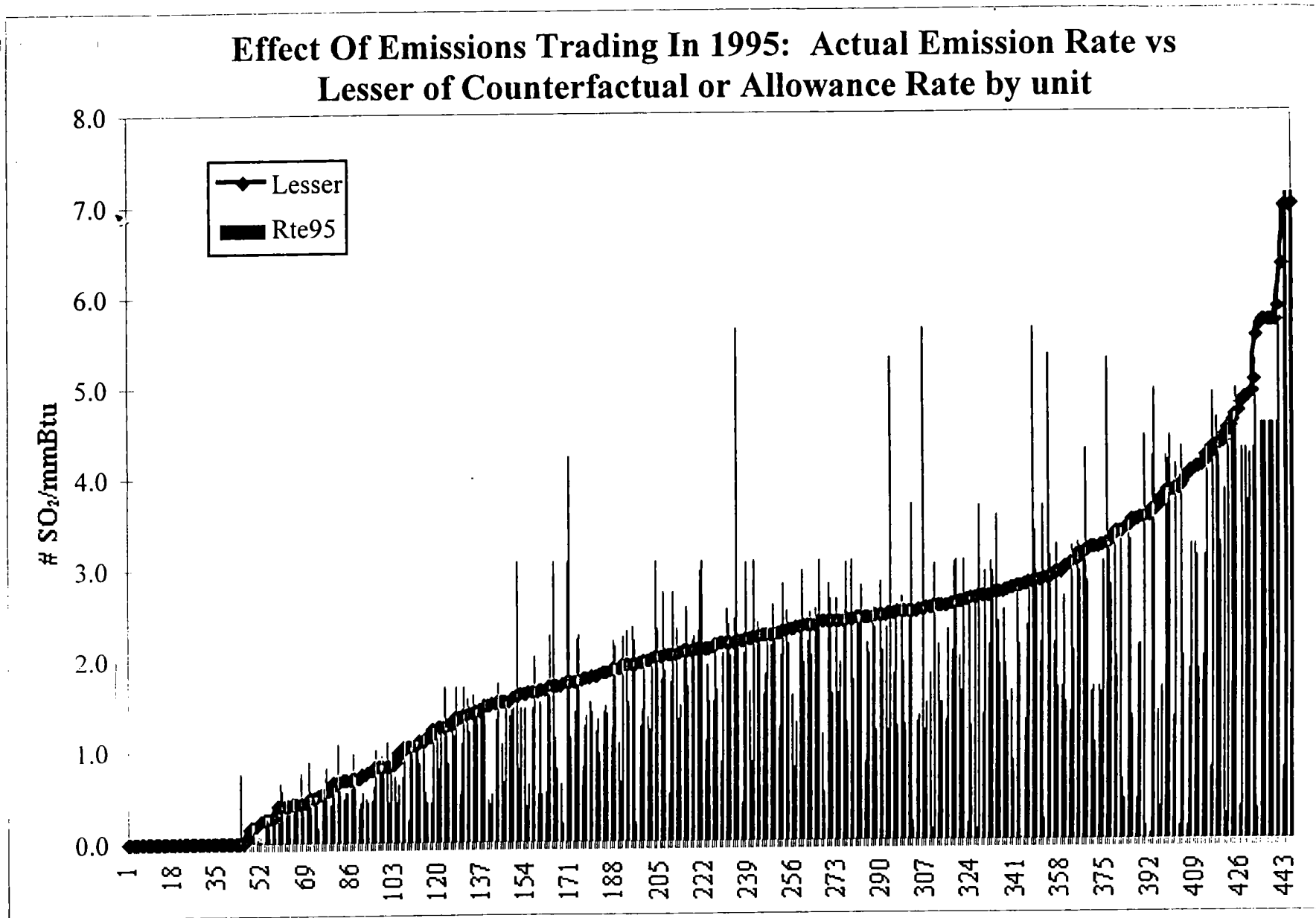
Figure 1

SO₂ Emissions, Caps and Forecast Phase I Units



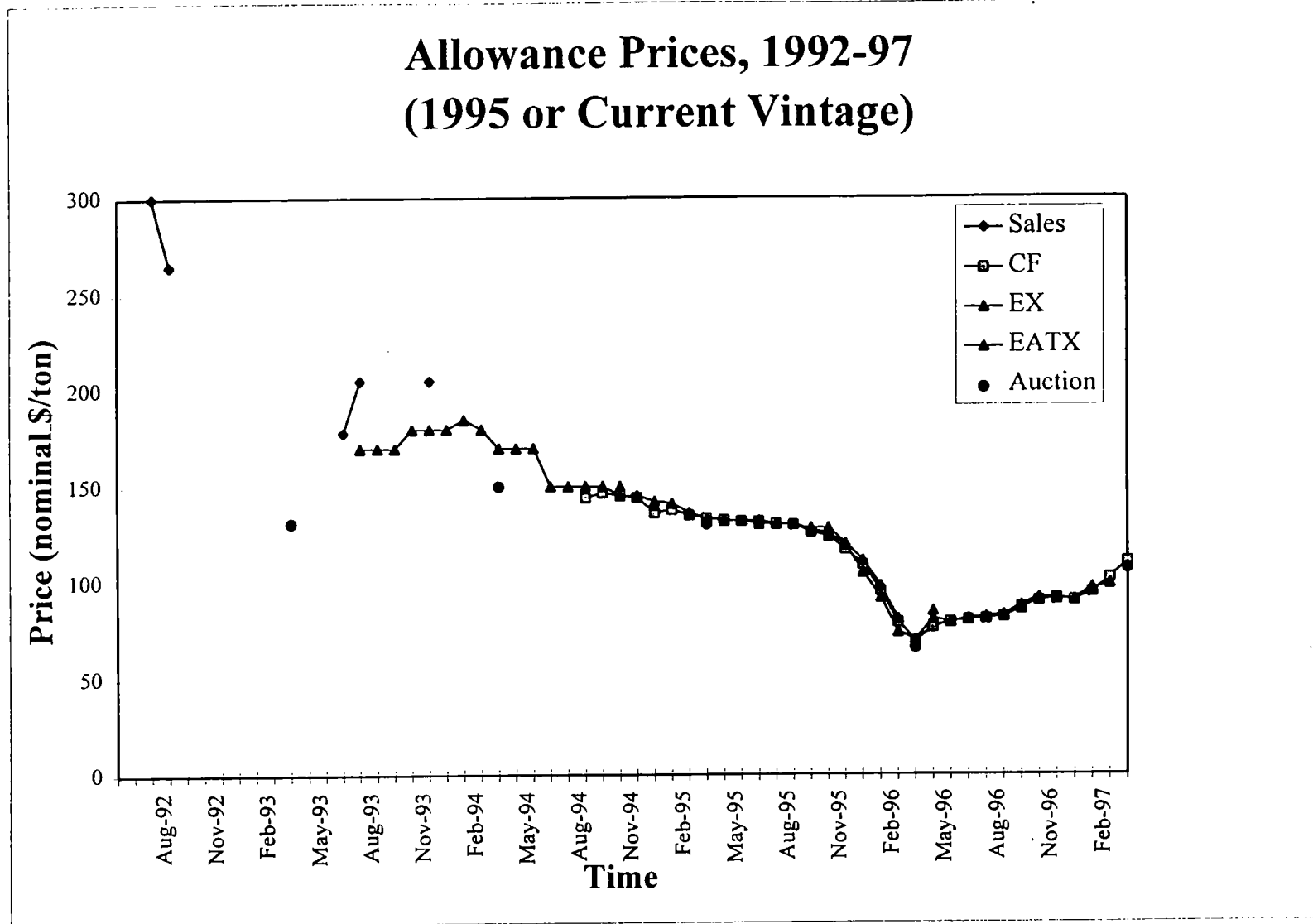
Source: Derived from Pechan (1995), EPA's ETS and ATS, and EPA (1996b).

Figure 2



Source: Derived from Pechan (1995), EPA's ETS, and EPA (1996b).

Figure 3



Source: Allowance Price Indications. 1993-97* Cantor Fitzgerald Environmental Brokerage, NY, NY.
 Compliance Strategy Review. 1992-97* Fieldston, Washington, DC.
 Exchange Value. 1993-97* Emission Exchange Corp. Escandido, CA.
 *Selected Issues

Date: December 18, 1996

To: Jeff Frankel, Ray Prince

From: Cristian Santesteban

Subject: Comments on the attached table

First, an explanation of the categories. Under Substitution Options, I list the choices that were available to firms in reducing emissions. These were:

- * **Same Scrubbing Installation/Technology:** maintaining the same scrubbing technology.
- * **New Scrubbing Installation/Technology:** upgrading to newer scrubbing technology or not installing redundant scrubbers (due to availability of allowances)
- * **Fuel Switching:** switching to low-sulfur Powder River Basin sub-bituminous coal.
- * **Fuel Blending:** blending bituminous coal from the east and midwest with sub-bituminous coal from the west
- * **Natural Gas**

Second, the studies presented here are the most important ones in the 89, 90, 91 time period for a number of reasons (there were others done in later years that don't concern us). ICF was the consulting firm to EPA who was the key player in the CAAA. RDI is another reputable industry consultant. AERX gives the state of the industry in the form of a survey. UMWA and AEP both have very strong vested interests. They prepared these estimates for a hearing on whether a certain coal plant (owned by AEP with UMWA members) should be shut down. Large projected allowance prices argues for continued mine utilization (less of a tendency to want disrupt then current practices).

Lastly, it is clear that ICF/EPA II has the lowest predictions of marginal costs/prices. They (along with RDI) have the better models. Also, looking at the UMWA and AEP model characteristics, it is not surprising that they have the highest estimates.

Please send me your comments. Thanks.

Estimates of Allowance Prices in SO2 Trading Program - (All estimates prior to 1991) - DRAFT -

	Actual	ICF/EPA I *	ICF/EPA II *	RDI	AERX	UMWA	AEP
<i>Phase I Price</i>	<80	N/A	170-200	310	450	980	400
<i>Phase II Price</i>		650-800	470	370	540	N/A	600
<i>Date</i>		Sept. 1989	July 1990	August 1991	October 1991	around 1990	around 1990
<i>Substitution Options</i>							
<i>Same Scrubbing Installation/Technology</i>		yes	yes	yes	N/A	yes	yes
<i>New Scrubbing Installation/Technology</i>		?	?	?	N/A	no	no
<i>Fuel Switching (to low-sulfur PRB Coal)</i>		no	no	yes	N/A	no	no
<i>Fuel Blending</i>		no**	no**	no	N/A	no	no
<i>Natural Gas</i>		?	?	yes	N/A	no	no
<i>Allowances Market</i>							
<i>Trading</i>		yes	yes	partial ***	N/A	yes	yes
<i>Banking</i>		no	partial ****	no	N/A	no	no
<i>Bonus allowances</i>		no	yes ****	yes	N/A	no?	no?

* ICF estimates are of marginal costs not allowance prices

** although these do take into account using different kinds of coal at different times

*** only trading within NERC (North American Electric Reliability Council) region

**** assumes that the bonus allowances are all banked

Note: ICF/EPA I analyzes a version of the bill that had stronger Phase II requirements than the final version making costs higher

References: (full citations later)

MIT Center for Energy and Environmental Policy Research

Jeremy Platt, EPRI

Dallas Burtraw, RFF

Bob Hahn, Jonathan Siskin, AEI

John Palmisano, Thad Huetteman, Andrew Van Horn

Bruce Mclean, Joe Krueger, EPA

Charles Bausell, Jr., GAO

Larry Metzroth, RDI

DRAFT

Estimates of Allowance Prices in SO2 Trading Program - (All estimates prior to 1991)

	Actual	ICF/EPA I	ICF/EPA II	RDI	AERX	UMWA	AEP
Phase I Price	\$0	N/A	170-200	310	450	980	400
Phase II Price		650-800	470	370	540	N/A	600
Date		Sept. 1989	July 1990	August 1991	October 1991	1990	1990
Substitution		yes	yes	yes	N/A	no	no
Trading		yes	yes	partial *	N/A	yes	yes
Banking		?	yes	no	N/A	no	no
Subsidized allowances **		yes	yes	yes	N/A	yes	yes
Endogenous Coal Market		no	no	no	N/A	no	no
Endogenous Scrubber Mkt		no	no	no	N/A	no	no
Fuel Blending ***		no	no	?	N/A	no	no

* only trading with NERC
 ** extra allowances due to scrubber investment
 *** fuel blending is a substitution option

RDI: Resources Data International, Inc.

AERX: AERX Industry Survey

UMWA: United Mine Workers of America

AEP: American Electric Power Public Utility

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