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State Implementation Plans: What Are They and Why Do They Matter?

A Primer on SIPs for Energy Regulators

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Executive Summary

The U.S. electricity system faces multiple urgent challenges during the next several years to address mounting transmission needs, adapt to smart grid technologies, expand energy efficiency and renewable energy use, and meet increasingly stringent environmental requirements. Air quality management faces equally daunting challenges imposed by the need for greater health and environmental protection, diminishing state and federal budgetary support, and aging regulatory approaches. During this time of compounded challenges, reliable, affordable, clean energy solutions are not likely to occur unless energy and air regulators work closely together and understand what motivates each agency and how each conducts its work.

During this time of compounded challenges, reliable, affordable, clean energy solutions are not likely to occur unless energy and air regulators work closely together, and understand what motivates each agency and how each conducts its work.

For energy regulators, such understanding begins with an appreciation of the federal Clean Air Act's provisions regarding National Ambient Air Quality Standards (NAAQS) and State Implementation Plans (SIPs). The Clean Air Act requires that the Environmental Protection Agency (EPA) establish health-based NAAQS; states must achieve those standards by developing and implementing a SIP, a comprehensive, multi-sector suite of measures to reduce pollutant emissions enough to meet the NAAQS. This primer details that process.

This report begins by discussing some of the differences between state energy regulatory and air quality agencies and describing ways in which each can help the other. The Clean Air Act is described briefly, including its history, main goals, types of pollutants regulated, impacts of those pollutants, and the roles of the EPA and states in implementing the law. This primer then discusses NAAQS, how they are developed, the components of the standards, and what happens when states do not attain the NAAQS. Finally, the SIP process is described, including how air regulations are developed and updated through that process. The SIP process has been effective at improving air quality, but deficiencies and criticisms exist, so the primer takes a quick look at how states are moving toward more effective, multi-pollutant-oriented air quality planning in the future.

The public demands reliable, affordable, clean energy solutions. By understanding the obligations, structure, and processes in which each agency acts, and working closely and purposefully to simultaneously meet state energy and air quality goals, energy and air quality regulators can best satisfy the public's interest. If energy regulators choose not to engage with their air quality counterparts in this quest, air regulators will be left with only those solutions under their control, which are reasonably likely to favor end-of-pipe options costing far more than solutions that are available under the energy regulators' control. Air officials, of course, have a similar obligation to engage with the energy regulators.

Introduction

The next several years will be an important and unsettled time for energy production and air pollution control in the United States. As the federal government adopts and implements new regulations to reduce harmful pollutant emissions and to address climate change, many power plants and large energy users will be impacted to a greater extent than in the past. In addition, new state policies associated with energy production and use will be necessary to meet federal air quality regulations. Just as the public seeks least-cost energy options, it also wants least-cost compliance with science-based, health-protective air quality standards. Due to the emissions impacts of the energy sector, and the expertise of public utility commissions (PUCs) in evaluating integrated resource portfolios and least-cost alternatives, least-cost air quality compliance is unlikely to be realized without the engagement of energy regulators. As a result, it will behoove energy and air quality regulators to collaborate to an unprecedented degree in order to ensure that policies to reduce air pollution and energy use are carefully coordinated to produce maximum synergies at the least possible cost.

It is clear that energy regulators' decisions affect air quality. Delivered electricity consumption is projected to increase by about 0.9% per year through 2035[1]; if this growth were to come at today's system average emission rates, overall air pollution would increase by about 24%, undoing the last 15 years or so of clean air progress and public health improvement. Similarly, air regulators' decisions impact the energy sector; the federal acid rain control program, for instance, successfully and cost-effectively reduced sulfur dioxide (SO_2) emissions through the first large-scale application of cap-and-trade. Installing SO_2 controls required capital expenditures, however, which required utilities to initiate cost recovery proceedings and energy regulators to adjust rates accordingly. By working closely together going forward, energy and air regulators have the opportunity to identify ways to simultaneously meet state energy goals and achieve compliance with air pollution regulations.

Energy officials can benefit from cooperation with air regulators; by considering air quality issues when choosing among various energy resources, they and the utilities they regulate can help reduce future environmental compliance costs and increase policy certainty regarding energy and environmental requirements in their states.

Energy officials can benefit from such cooperation; by considering air quality issues when choosing among various energy resources, they and the utilities they regulate can help reduce future environmental compliance costs and increase policy certainty regarding energy and environmental requirements in their states. In addition, new air pollution regulations will provide a new impetus, rationale, and set of options for energy efficiency efforts. Air regulators can similarly benefit from energy regulators' input as they seek to apply new regulations to the power sector; working together will facilitate the identification of better, more flexible ways to comply with air pollution regulations. Because they are accustomed to integrated planning approaches, for example, energy officials may be able to help air regulators develop more effective, multi-pollutant approaches to addressing pollution.

As the work of energy and air officials overlaps more and more, it is crucial for each to better understand the obligations, structure, and processes in which the other acts. Although the work of energy and air officials may increasingly overlap, each has distinct missions, statutory authorities, and responsibilities.

1 U.S. Energy Information Administration, 2011

Much of the statutory authority of state air regulators, for example, flows directly from the Clean Air Act and is delegated to states to implement. State, local, and tribal air officials[2] are responsible for meeting the requirements of the Act by undertaking air quality management planning for their jurisdictions and developing and implementing regulatory programs to control air pollution.[3] This contrasts markedly with the broad, state-specific statutory authority of most PUCs. The processes employed by air quality and utility regulators also differ significantly; whereas utility commissions typically initiate dockets, qualify intervening parties, hold quasi-judicial proceedings, and determine orders based solely on the evidentiary record derived, environmental regulators generally issue proposed regulations, seek public comment, conduct one or more public hearings, revise the proposed rule as necessary, and promulgate it. Subsequent challenges are then litigated in the courts.

Much of the statutory authority of state air regulators flows directly from the Clean Air Act and is delegated to states to implement. State, local, and tribal air officials are responsible for meeting the requirements of the Act by undertaking air quality management planning for their jurisdictions and developing and implementing regulatory programs to control air pollution. This contrasts markedly with the broad, state-specific statutory authority of most PUCs.

Electric system reliability is a primary obligation of energy regulators, whereas healthy air quality – as measured by adherence to or "attainment" of federal standards – is a principal duty of air quality regulators. Energy officials monitor reliability through such metrics as system average interruption duration and frequency indices.[4] They address reliability deficiencies through specific response proceedings, such as construction preapproval and/or general system demand projections and utility-specific efforts, like integrated resource planning. Ultimately, elected officials oversee energy regulators' performance, or the regulators stand for election directly. Air quality officials measure exceedances of air quality standards at monitoring stations, and address "nonattainment" deficiencies by adopting emission control measures and incorporating them into SIPs mandated by the federal Clean Air Act. As officials of executive branch agencies, they too ultimately report to elected officials, although the EPA also judges their performance as to whether the SIPs they submit are approvable.

In support of greater common understanding, this guide for energy officials provides background information regarding SIPs, a key cornerstone of air pollution control in the United States under the federal Clean Air Act. SIPs, and the health-based NAAQS that they address, are the primary means by which states develop – and the federal government enforces – programs and policies to reduce ambient air pollution as required by the Clean Air Act. Although air officials often find the process for developing SIPs to be onerous, the process provides the framework, impetus, and funding for states to monitor and ensure healthy air quality.

The following sections of this paper provide background for energy officials on the federal Clean Air Act and the EPA's implementation of it; the role of state, local, and tribal governments under the Act; NAAQS; and SIPS. Concluding sections reflect on the historical effectiveness of the Clean Air Act, and on some jurisdictions' efforts to undertake more comprehensive, integrated, and cost-effective air quality management planning that can be far more state-specific and may encompass air quality goals that exceed federal requirements or address issues not covered in federal law.

2 Unless otherwise noted, references to "states" in this paper are intended to apply generally to state, local, and tribal air quality jurisdictions.

3 The five key air quality management tools include ambient standards, control measures, licensing/permitting, enforcement, and assessment.

4 The Institute of Electrical and Electronic Engineers (IEEE) defines several reliability indices in IEEE-P1366, "Guide for Electric Distribution Reliability Indices." Among the most common are the System Average Interruption Duration Index (SAIDI), System Average Interruption Frequency Index (SAIFI), Customer Average Interruption Duration Index (CAIDI), Customer Average Interruption Frequency Index (CAIFI), Customers Interrupted per Interruption Index (CIII), and the Average Service Availability Index (ASAI).

A Brief Overview of the Clean Air Act

The federal Clean Air Act[5] is a far-reaching statute that requires the EPA to control air pollutants known to be harmful to human health and environmental welfare. The current law reflects amendments enacted in 1990, but the roots of the Clean Air Act go back as far as the 1950s. In 1955, Congress passed the Air Pollution Control Act; it established air pollution research and technical assistance at the federal level but left states and municipalities in charge of air pollution control. The first Clean Air Act, passed in 1963, launched a federal program for air pollution control within the U.S. Public Health Service and established additional research into monitoring and controlling air pollutants. Federal efforts expanded with the 1967 Air Quality Act, when enforcement proceedings related to interstate air pollution transport commenced, and emission inventories, monitoring studies, and control activities were established.

> **The first strong, comprehensive federal program to control air pollution came about with the 1970 amendments to the Clean Air Act. Four major new elements – which have since become cornerstones of federal air policy – were instituted: NAAQS, SIPs, NSPS, and NESHAPs. All four have significant impacts on electric generating units.**

The first strong, comprehensive federal program to control air pollution, however, came about with the 1970 amendments to the Clean Air Act. This legislation created federal requirements to limit emissions from stationary, mobile, and other air pollution sources.[6] Four major new elements – which have since become cornerstones of federal air policy – were instituted: NAAQS, SIPs, New Source Performance Standards (NSPS), and National Emission Standards for Hazardous Air Pollutants (NESHAPs). All four have significant impacts on electric generating units. Also created in 1970 was the EPA itself. The new agency was immediately tasked with implementing the Clean Air Act, initiating a significant expansion of the federal government's planning and enforcement authority regarding air pollution.

Major amendments to the Clean Air Act were subsequently made in 1977 and 1990. The 1990 amendments significantly increased the authority and responsibility of the federal government for air pollution, and included new programs for acid rain, an expanded program for controlling toxic air pollutants, and new provisions for attaining and maintaining the NAAQS.

As reflected in the 2004 National Research Council report, Air Quality Management in the United States, the main goals of the Clean Air Act are:

- Mitigating harmful human and environmental exposure in the ambient air from the "criteria" pollutants: ground-level ozone, particulate matter, sulfur dioxide, nitrogen oxides, carbon monoxide, and lead;
- Limiting the sources of and risks from hazardous air pollutants (HAPs), also called air toxics;
- Protecting and improving visibility impairment in wilderness areas and national parks;
- Reducing the emissions of pollutants that cause acid rain: sulfur dioxide and nitrogen oxides; and
- Curbing the use of chemicals that deplete the stratospheric ozone layer.[7]

A key characteristic of the Clean Air Act is that it distinguishes between two distinct kinds of air pollutants, so-called "criteria" pollutants and "toxic" or hazardous pollutants. "Criteria" pollutants are those for which NAAQS have been promulgated. The management of criteria pollutants is largely accomplished through control measures tailored by state, local, and tribal governments in their SIPs, as described below. Toxic compounds, however, are primarily regulated at the federal level (except where states have chosen to go beyond minimum Clean Air Act requirements). Table 1 shows the health and welfare effects of these pollutants, along with some of their sources.

5 U.S. Code 42 § 7401 et. seq.

6 "Stationary sources" typically reflect industrial facilities – factories, power plants, refineries, smelters, and the like. "Mobile sources" are vehicles, both on-road (i.e., cars and trucks) and off-road (e.g., construction equipment, agricultural equipment). A third category, called "area sources," reflects small, typically commercial facilities like dry cleaners, bakeries, paint shops, and so on that individually have small air quality impacts but in aggregate may have impacts warranting regulation.

7 National Research Council, 2004

Table 1

Examples of Health and Welfare Impacts of Various Pollutants[8]

Pollutant	Examples of Sources	Health Effects	Welfare Effects
Ozone (O_3)	Formed in the atmosphere from volatile organic compounds (e.g., vehicle exhaust) and oxides of nitrogen in the presence of sunlight	Eye and throat irritation, coughing, respiratory tract problems, asthma, lung damage	Damage to crops, forests, other plants and ecosystems
Particulate Matter (particles, soot, or PM)	Diesel engines, power plants, industries, windblown dust, wood stoves	Eye irritation, asthma, bronchitis, lung damage, cancer, heavy metal poisoning, cardiovascular effects, premature mortality	Visibility impairment, atmospheric deposition, aesthetic damage
Sulfur Dioxide (SO_2)	Coal-fired electric power plants, petroleum refineries, manufacture of sulfuric acid and smelting of ores containing sulfur	Eye irritation, wheezing, chest tightness, shortness of breath, lung damage	Contributes to the formation of acid rain, visibility impairment, plant and water damage, aesthetic damage
Nitrogen Dioxide (NO_2)	Motor vehicles, electric power plants, and other industrial, commercial, and residential sources that burn fuels	Susceptibility to respiratory infections, irritation of the lung and respiratory symptoms (e.g., cough, chest pain, difficulty breathing)	Contributes to the formation of ozone smog, acid rain, water quality deterioration, global warming, and visibility impairment
Carbon Monoxide (CO)	Motor vehicle exhaust, indoor sources include kerosene or wood burning stoves	Headaches, reduced mental alertness, heart attack, cardiovascular diseases, impaired fetal development, death	Contributes to the formation of ozone smog
Lead (Pb)	Metal refineries, lead smelters, battery manufacturers, iron and steel producers	Anemia, high blood pressure, brain and kidney damage, neurologic disorders, cancer, lowered IQ	Affects animals and plants, affects aquatic ecosystems
Heavy Metals (e.g., Mercury, Arsenic, Chromium, Cadmium)	Combustion of coal and oil, industrial processes (many are PBTs: persistent toxins that bioaccumulate in the food chain)	Associated with a variety of cancer impacts as well as neurologic development, renal (kidney) dysfunction, and a number of other impacts	Animals may experience similar health problems as humans
Toxic Compounds (Hazardous Air Pollutants [HAPs])	Vehicles, industrial processes, factories, refineries, power plants, building materials, solvents, cleaners, and so on. Some toxics are also emitted from natural sources (e.g., volcanic eruptions and forest fires)	Cancer and other serious health effects including damage to immune, neurologic, reproductive, and respiratory systems and developmental effects	Animals may experience similar health problems as humans

8 U.S. Environmental Protection Agency, 2010a

The EPA implements, administers, and enforces the Clean Air Act at the federal level. Its role is primarily to:

1. Establish acceptable (e.g., health-protective) concentrations of pollutants in the ambient air;
2. Establish emission limits and other regulatory requirements for controlling them;
3. Revise the ambient and emissions standards in accordance with prescribed schedules that reflect and incorporate scientific developments; and
4. Enforce the emission standards as necessary.

Since 1970 the EPA has revised, strengthened, and established new standards several times, and has routinely issued related regulations and guidance documents.

Consistent with these provisions, since 1970 the EPA has revised, strengthened, and established new standards several times, and has routinely issued related regulations and guidance documents. Among the agency's many actions, the EPA adopted new NAAQS for ground-level ozone and fine particulate emissions in 1997, revising the standards again for particulates in 2006 and for ozone in 2008. Following the U.S. Supreme Court's 2007 decision in Massachusetts et al v. EPA, greenhouse gas (GHG) emissions from stationary and mobile sources became subject to regulation under the Clean Air Act, starting with GHG emission reporting requirements for large sources in 2011.[9] In addition, two major new regulations affecting the power sector – the Cross-State Air Pollution Rule[10] (CSAPR) and Mercury and Air Toxics Standards (MATS) – were finalized in 2011.[11]

These and other regulatory programs of the Clean Air Act typically seek to address one or more public health issues or welfare concerns. As shown in Table 2, however, some pollutants contribute to more than one air quality problem, so it is not uncommon for emissions of individual pollutants to be regulated under multiple Clean Air Act programs, often with differing parameters in terms of applicability, reduction requirements, and timeframes. This can lead to understandable confusion and frustration on the part of the regulated community.

Although this paper focuses on NAAQS and SIPs, there are many additional provisions of the Clean Air Act, the implementation of which typically involves requirements that are incorporated into state SIPs. Described further below, these provisions include Prevention of Significant Deterioration, NSPS, New Source Review, the Regional Haze program, and others.

The Role of State, Local, and Tribal Governments Under the Clean Air Act

Although the Clean Air Act is a federal statute, much of its implementation for criteria pollutants is "delegated" to state, local, and tribal governments. This structure recognizes that because air quality issues vary widely with respect to different geographic areas, different pollutants, and different emission sources, these jurisdictions may be better positioned than the EPA to design geographically

Table 2

Pollutants Regulated by Certain Clean Air Act Programs

Clean Air Act Program	SO_2	Nitrogen Oxides (NO_X)[12]	Volatile Organic Compounds (VOCs)[13]	Mercury and Other Toxic Compounds	GHGs
Acid Rain	•	•			
Ozone		•	•		
Particulate Matter	•	•			
Mercury and Toxics			•	•	
Regional Haze	•	•			
Permitting	•	•	•	•	•

9 U.S. Code of Federal Regulations, 2012

10 On December 31, 2011, implementation of CSAPR was stayed by the DC Circuit. The Court heard oral arguments on April 13, 2012, and a decision is expected later in 2012.

11 For more information, see http://www.epa.gov/crossstaterule/ (CSAPR) and http://www.epa.gov/airquality/powerplanttoxics/ (MATS).

12 NO_X is regulated because ground-level ozone is formed by an atmospheric reaction of NO_X and VOCs.

13 Some toxic compounds are emitted in the form of VOCs.

optimal pollution control solutions. The EPA establishes health-based ambient pollution concentration standards (i.e., the NAAQS), and designates areas as being in "attainment" or "nonattainment" of those standards. State and local governments are required to work with the EPA to develop and implement SIPs[14] that will reduce emissions sufficiently to achieve attainment within the period specified by the Clean Air Act.

State governments are responsible for monitoring ambient air quality, inspecting facilities, and enforcing the regulations that comprise the SIP. They must also demonstrate to the EPA at regular, three-year intervals that progress toward attainment is being made. The EPA must approve state plans to meet the NAAQS, and can impose sanctions if they are inadequate, untimely, or not implemented. State plans also become "federally enforceable," such that the EPA can step in and enforce them directly if state governments fail to do so. In exchange for carrying out these federally delegated Clean Air Act provisions, states receive funding and assistance from the EPA for their state and local air quality programs. The Clean Air Act also requires states to collect annual emission fees (assessed as dollars per ton emitted), from major sources. Most states also charge for pre-construction review and preparation of the draft construction permit.

Although the Clean Air Act is a federal statute, much of its implementation for criteria pollutants is "delegated" to state, local, and tribal governments. This structure recognizes that because air quality issues vary widely with respect to different geographic areas, different pollutants, and different emission sources, these jurisdictions may be better positioned than the EPA to design geographically optimal pollution control solutions.

National Ambient Air Quality Standards

The Clean Air Act requires the EPA to develop NAAQS to regulate pollutants present in the ambient (outside) air that are harmful to human health and the environment and that result from numerous and diverse stationary or mobile sources. Other air pollutants – such as toxic compounds – are regulated as well, but typically through rate-based or absolute emission limits on specific sources rather than NAAQS. The Clean Air Act identifies two types of NAAQS: primary standards, providing public health protection, including protection for sensitive populations; and secondary standards, providing protection against damage to animals, crops, vegetation, buildings, and decreased visibility. Reflecting their derivation, primary standards are often referred to as "health standards," and secondary standards are often called "welfare standards." It is important to note that the Act requires the EPA to base its NAAQS decisions solely on medical and scientific information about health and welfare impacts. Economic impacts are considered as regulations are developed and implemented, but not in determining the NAAQS themselves.

The EPA has set NAAQS for the six "criteria" pollutants: carbon monoxide, nitrogen dioxide, sulfur dioxide, lead, ozone, and particulate pollution (both coarse and fine particles[15]). Some of these pollutants are emitted directly from sources (e.g., SO_2, CO, lead). Others are formed in the atmosphere by chemical reactions involving precursor pollutants; ground-level ozone, for instance, is created in the atmosphere through reactions of oxides of nitrogen (NO_X) and volatile organic compounds (VOCs) in the presence of sunlight. Some pollutants, such as fine particulate matter, are both emitted directly and also formed by reactions in the atmosphere. Adding to this already complex picture is the fact that some criteria pollutants occur naturally to varying degrees (e.g., low levels of ozone, particulate matter from wildfires and dust, and certain VOCs from trees and other plants). Further, virtually all of these pollutants can be transported by prevailing winds to other jurisdictions, although typical transport distances vary greatly.

The EPA establishes a standard for each criteria pollutant – designated as a primary or secondary standard (or both) – that includes an averaging time over which the pollutant is measured, a physical limit (typically expressed as the concentration of the pollutant in the outdoor air), and a

14 Tribal jurisdictions may develop Tribal Implementation Plans (TIPs) instead of SIPs, but are not required to do so. Since 1998, Tribes have express authority to manage air quality on their reservations. 40 CFR 49 specifies tribal authority under the Clean Air Act.

15 Coarse particulate matter denotes airborne particles 10 microns in diameter or smaller, and is often referred to as PM_{10}. Fine particulate matter denotes particles 2.5 microns in diameter or smaller, and is similarly labeled $PM_{2.5}$.

provision that stipulates whether or how often the limit can be exceeded and still allow an area to meet the NAAQS for that pollutant. For example, under the NAAQS for ground-level ozone established in 2008, the averaging period is eight hours, the limit is 0.075 parts per million (ppm) (although it is commonly referred to as 75 parts per billion [ppb]), and areas are not considered to be violating the NAAQS until the three-year average of the annual fourth-highest daily maximum 8-hour average concentration at any ozone monitor is greater than 0.075 ppm. In other words, the three highest ozone occurrences (or "exceedances") per year are discarded, but the fourth one "counts" toward the three-year average. If the three-year average is greater than the ozone NAAQS of 0.075 ppm, then the area "violates" the standard. Although it sounds complex, this form of the NAAQS increases regulatory stability and provides a better gauge of ozone's actual health risks. States may set standards that are stronger, but not weaker, than the NAAQS.[17]

States are required to monitor and analyze ambient concentrations of criteria pollutants throughout their jurisdictions, and the EPA provides funding for these activities. Based on monitored data, the EPA designates counties as being in "attainment" or "nonattainment" for each criteria pollutant, depending on whether ambient pollutant concentrations in the area violate the NAAQS. In the case of broad urban areas, the EPA often applies consistent designations across census-based metropolitan statistical areas (MSAs) or consolidated MSAs (CMSAs). Such designations may include counties in more than one state. An area may be in attainment for some pollutants, and nonattainment for others. Designated nonattainment areas are also classified with respect to the severity of their unhealthy pollution levels; areas with more severe pollution must adopt more stringent control measures but are given more time to attain the NAAQS. Table 3 shows nonattainment classifications, corresponding pollutant thresholds in the atmosphere (called design values[18]), and number of years allowed to reach attainment for 8-hour ground-level ozone.

During the 1970s and 1980s, many areas had unhealthy pollution levels, especially for ozone and particulate matter. As a result, beginning in 1977 Congress established prescriptive program mandates for nonattainment areas. In 1990 Congress made additional changes, including ranking areas as to the severity of their ozone, carbon monoxide, and particulate matter pollution. Congress also specified new general mandates for all nonattainment areas and a number of more specific requirements for ozone and particulate matter pollution (see Appendix A for a sample list). Currently, areas that do not attain the ozone and particulate matter NAAQS by their deadlines are immediately reclassified to the next highest level of severity. This gives the area more time to attain the standard, but also requires it to adopt the more stringent and prescriptive control measures specified for that severity classification.

Another important change that came with the 1990 Clean Air Act Amendments was greater recognition

Table 3

Nonattainment Severity Classifications under the 8-Hour Ozone NAAQS [16]

Area class	8-hour design value (ppm ozone)	Primary Standard Attainment Date (years after designation for 2008 primary NAAQS)
Marginal	From 0.076 Up to 0.086	3 years after December 31, 2012
Moderate	From 0.086 Up to 0.100	6 years after December 31, 2012
Serious	From 0.100 Up to 0.113	9 years after December 31, 2012
Severe-15	From 0.113 Up to 0.119	15 years after December 31, 2012
Severe-17	From 0.119 Up to 0.175	17 years after December 31, 2012
Extreme	Equal to or above 0.175	20 years after December 31, 2012

** but not including*

16 Federal Register, 2012

17 States may also establish standards for pollutants for which there are no federal equivalents.

18 Under the Clean Air Act, states are allowed to have one ozone exceedance per year averaged over a three-year period. A fourth violation in that period leads to that area being classified as nonattainment. Data from the three-year period are reviewed, and the fourth highest concentration is the design value. The level of the design value determines that area's specific classification, as shown in Table 3.

that air pollution is often transported by prevailing winds from upwind jurisdictions to downwind ones. Specifically the Act imposed upon states whose emissions contribute materially to nonattainment areas in downwind states an obligation to reduce their own emissions in order to make it possible for downwind areas to have healthy air. This obligation applies even if the upwind state itself is in attainment of the NAAQS. Recognizing that air pollution does not respect state borders and that the eastern United States had suffered for decades from unhealthy ozone levels, the 1990 Amendments also designated an area from Maine to northern Virginia as the "Northeast Ozone Transport Region." States in this region are required to implement prescribed control measures, even in counties that are in attainment for ozone. Atmospheric science has progressed significantly since 1990, reinforcing the need to reduce interstate transport of air pollution. In fact, the core purpose of the EPA's recent CSAPR rule is to address this obligation.

The Act imposed upon states whose emissions contribute materially to nonattainment areas in downwind states an obligation to reduce their own emissions in order to make it possible for downwind areas to have healthy air. This obligation applies even if the upwind state itself is in attainment of the NAAQS.

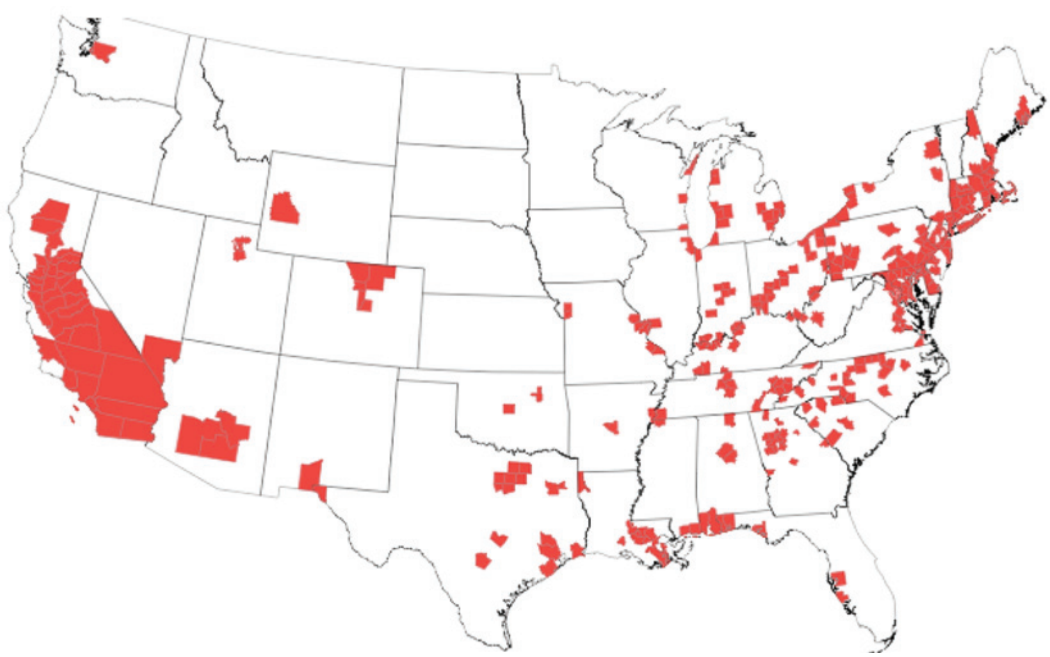
The Clean Air Act requires the EPA to review all NAAQS periodically to determine whether the standards for each criteria pollutant should be revised based on new medical or scientific evidence. Generally reviews are to take place at five-year intervals, but they include many phases and stakeholders and are complicated and time-consuming; it often takes many years to review and revise a single NAAQS. The NAAQS for ground-level ozone, for example, was revised in 1997, again in 2008, and may be changed again soon.[19] Periodic review of the NAAQS is not optional at the EPA's discretion, however; it is an obligation under the Act. The EPA is regularly sued – and regularly loses in court – when it fails to comply with this obligation.

The ramification of periodic NAAQS revisions is evident in Figures 1 and 2. Figure 1 shows areas in nonattainment of the 2008 NAAQS for ground-level ozone (75 ppb) based on 2006-2008 monitoring data. Figure 2 illustrates areas that would be in nonattainment of the same NAAQS were it revised to a level of 70

Figure 1

Areas in Nonattainment of the 2008 NAAQS for Ground-Level Ozone[20]

Counties with Monitors Violating the March 2008 Ground-level Ozone Standards
0.075 parts per million (Based on 2006-2008 air quality data)



322 of 675 monitored counties violate the standard

Notes:
1. *Counties with at least one monitor with complete data for 2006-2008.*
2. *To determine compliance with the March 2008 ozone standards, the 3-year average is truncated to three decimal places.*

19 The EPA is scheduled to review whether the existing ozone standard is adequate to protect public health and the environment in 2013.

20 U.S. Environmental Protection Agency, 2010b

ppb, 65 ppb, or 60 ppb and assuming nonattainment designations were made on the basis of the same 2006-2008 monitoring data. If the NAAQS for ground-level ozone were set to one of these more stringent levels, the number of counties in nonattainment would increase by 60%, 90%, or more than double, respectively. The fact that EPA is required to reassess NAAQS regularly – and to revise them if scientifically warranted – suggests that states should continually seek cost-effective emission reduction opportunities in order to reduce the risk of a future nonattainment classification and its attendant obligations.

State Implementation Plans

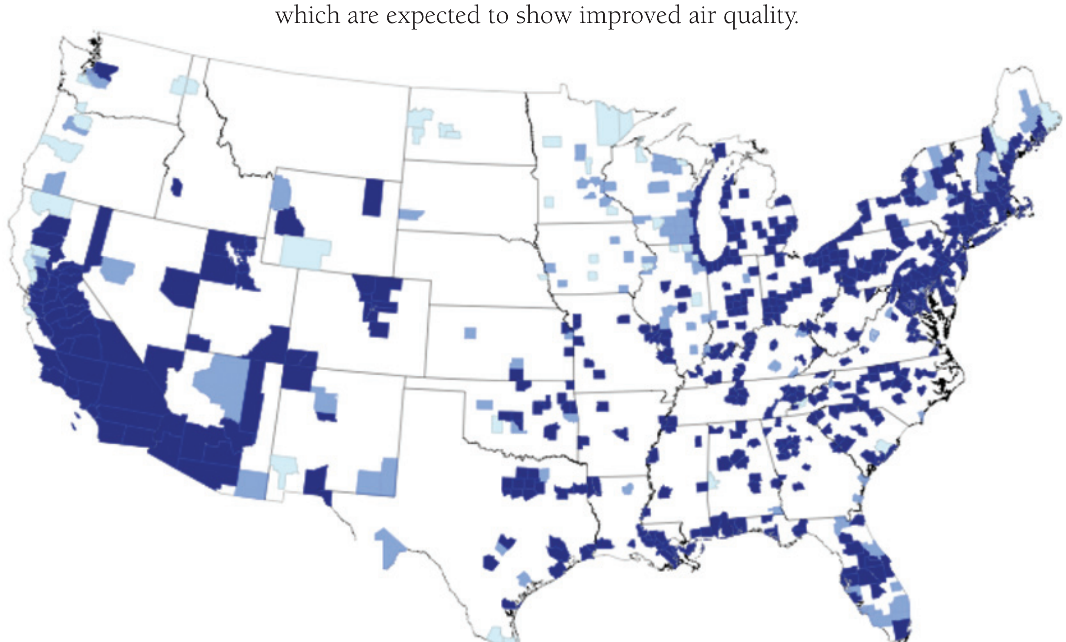
A SIP is a collection of emission reduction regulations, policies, and programs developed by state air quality agencies that together are expected to enable the state to attain or maintain the NAAQS by a date certain. SIPs must be submitted to and approved by the EPA. SIPs have been required under the Clean Air Act since 1970, and the EPA approved the first SIPs for states, territories, and the District of Columbia in 1972. Since then, most states have submitted many SIP revisions, either on their own initiative or because they were required to do so by subsequent Clean Air Act amendments or revisions to air pollution standards. Although attainment of NAAQS is the most prevalent role of SIPs, they are also often employed by states to secure delegation of several Clean Air Act programs unrelated to the NAAQS as well.[22]

States with nonattainment areas for one or more criteria pollutants must identify, adopt, and incorporate into an "attainment demonstration SIP" a comprehensive suite of emission reduction measures (often including prescriptive

Figure 2

Areas Potentially in Nonattainment of a Future NAAQS for Ground-Level Ozone[21]

Counties with Monitors Violating Primary 8-hour Ground-level Ozone Standards
0.060 – 0.070 parts per million (Based on 2006-2008 air quality data)
EPA will not designate areas as nonattainment on these data, but likely on 2008-2010 data which are expected to show improved air quality.



515 counties violate 0.070 ppm

93 additional counties violate 0.065 ppm for a total of 608

42 additional counties violate 0.060 ppm for a total of 650

Notes:

1. *No monitored counties outside the continental U.S. violate the standards.*
2. *EPA is proposing to determine compliance with a revised primary ozone standard by rounding the 3-year average to three decimal places.*

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21 U.S. Environmental Protection Agency, 2010c

22 Certain sections of the Clean Air Act (e.g., New Source Performance Standards, National Emission Standards for Hazardous Air Pollutants) require the EPA to establish emissions standards applicable on a nationwide basis. In order for states to assume the EPA's enforcement role for these standards, they must adopt measures at least as stringent as the federal rules. States typically do so by adopting these standards into their SIP and submitting it to the EPA for review. After the EPA's approval, the state is delegated authority/responsibility for enforcement of those provisions. Until such time as these programs are delegated to the State, the EPA is the primary enforcement agency. For more information see http://www.epa.gov/region1/topics/air/sips/REVISED_WHATS_NOT_IN_A_SIP.pdf

measures required by the Clean Air Act) that will improve air quality in the area from nonattainment to attainment by a date certain. Once it reaches attainment, a state is required to file a "maintenance SIP" to ensure that its air quality remains healthy going forward, and what specific actions the state will take if it does not. States also must submit general "infrastructure" elements within their SIPs to demonstrate that they meet basic program conditions for managing air quality and have the capacity to attain, maintain, and enforce a new or revised NAAQS. States are also subject to occasional "SIP calls" by the EPA that compel them to adopt certain emission controls on certain sources. The agency's recent CSAPR rule, which requires reductions in SO_2 and NO_X emissions from electric generating units in 28 eastern states, reflects this approach.

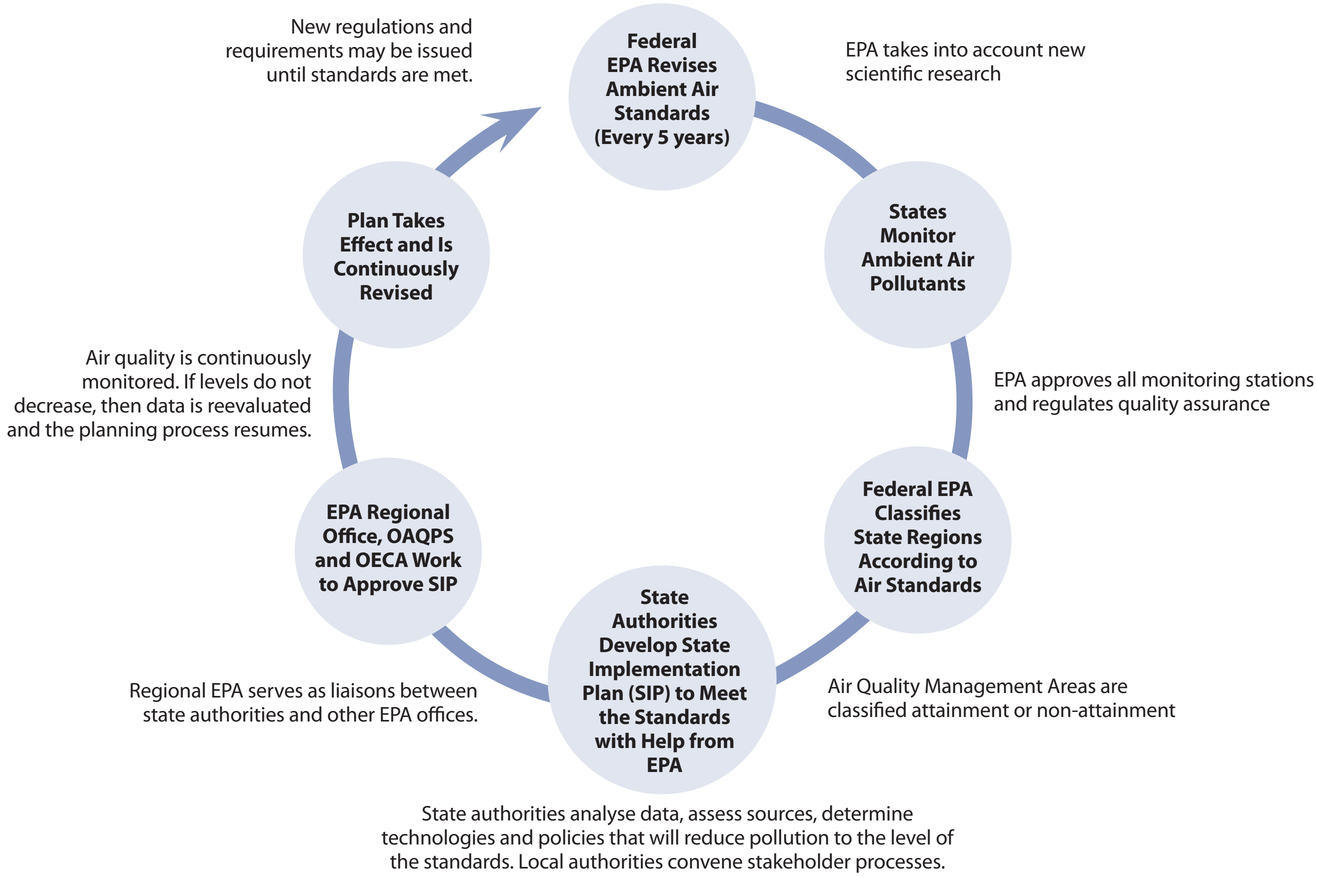
The SIP process begins when an NAAQS is established or revised. Depending on their air quality status, states may need to make many or few SIP submittals. A state may submit a SIP to address ground-level ozone, for instance, and another one to address particulate matter pollution. Some SIP submittals are voluminous filings (e.g., to address a first-time nonattainment designation); other SIP revisions are essentially administrative in nature. Accordingly, SIPs are not "plans" in the traditional sense; there is no three-ring binder at the front desk of the Department of Environmental Protection containing "the SIP." Rather, a nonattainment state's SIP filings typically span thousands of pages reflecting federal obligations, adopted regulations, modeling, data sets, assumptions, public comments, and so on. Figure 3 illustrates the overall SIP process and also reflects the fact that NAAQS are occasionally revised based on periodic scientific reviews.

States are required to operate a network of air quality testing devices that measure the concentrations of

23 James, 2012. Based on an earlier graphic characterizing the iterative nature of air quality management in National Research Council, 2004, 34. OAQPS is the EPA's Office of Air Quality Planning and Standards; OECA is the EPA's Office of Enforcement and Compliance Assurance.

Figure 3

Illustration of Periodic NAAQS Revisions and State SIP Processes under the Clean Air Act [23]



pollutants in the ambient air, activities that are funded by the EPA. Based on the monitored data, state governors propose attainment or nonattainment classifications for each county. The EPA adjusts these as necessary and determines the final designations. Nonattainment counties are then obligated to develop a SIP within three years that lays out an enforceable set of measures that it will implement to reach attainment.

In order to develop a SIP, state air agencies enter monitored ambient air quality data and inventoried emissions data for each source category into air quality models to create a baseline of existing conditions. These air quality models assess the effects of pollution sources and whatever control measures are implemented to reduce pollution.[24] States and the EPA input actual air quality monitoring data, using data from the monitor with the highest recorded concentrations of the pollutant(s) to be controlled in the state (or metropolitan area), and emissions inventory data for stationary, area, and mobile source categories.[25] The reason the highest pollutant concentration in a state is used is that when new control measures are developed and modeled, if they show air quality improving sufficiently at the sites where ambient pollutant readings are highest, then all other locations in the modeled domain will assuredly attain the air quality standard as well. Then, the projected emission reductions associated with different pollution control strategies are modeled to determine their impacts on air quality. By iteratively conducting this process in consultation with the EPA, states ultimately arrive at a combination of measures that are expected to lower emissions enough to meet the NAAQS.

Air quality modeling is immensely complex due to highly variable emissions, wind, and weather affecting the inherently dynamic atmospheric chemistry involved. As a result, most air quality modeling has been limited to the interplay of policy goals (e.g., regulatory targets), emissions, meteorology, time, and ambient pollutant concentrations. Scientific understanding of the underlying processes has improved, however, as has understanding of health impacts, climate change impacts, and energy system and economic considerations. As a result, it is increasingly possible to integrate multidisciplinary modeling (e.g., air quality, health, energy, and economic) in order to provide decision makers with a far more comprehensive and dynamic appreciation of available options and the ramifications of their choices. Figure 4 (page 14) illustrates the conceptual elements of an integrated model framework.

Air pollution regulations typically specify the sources affected, emissions limits, how compliance is measured and assured, recordkeeping and reporting requirements, and penalties in the event of violations.[26] Collectively the pollution measures described in the SIP, together with emissions reductions from federal programs implemented by the EPA (e.g., motor vehicle emission standards), must remove sufficient pollution from the air to attain the NAAQS, as indicated by the air quality modeling. And where transported pollution is an issue, they must reduce emissions sufficiently to enable counties in neighboring states downwind to attain the NAAQS as well. Although the pollution measures chosen by states may vary substantially, their emission reductions generally must adhere to five key Clean Air Act requirements: that they be real, surplus, permanent, quantifiable, and enforceable:

- **Real:** There must be a reduction in actual emissions, resulting from a specific and identifiable action or undertaking.
- **Surplus:** The pollution control measure must reduce emissions above and beyond reductions required by other mandatory air pollution programs.
- **Permanent:** The emissions reductions produced by the pollution control measure must be permanent.

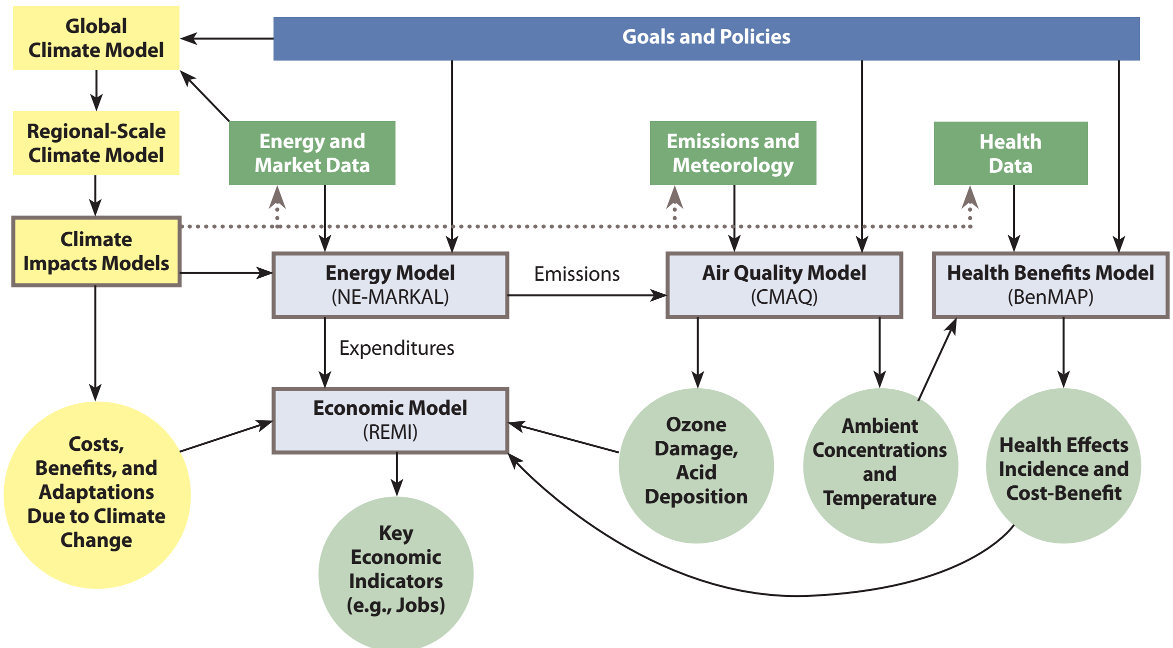
24 All models used must be EPA-approved. The EPA has developed most of the air quality models used by states. For more information see http://www.epa.gov/scram001/guidanceindex.htm.

25 Actual emissions from stationary sources are input to the air quality model. Data from area sources are obtained from demographic factors relevant to the individual state. Mobile source emissions data are usually obtained from the EPA and adjusted as appropriate to the state's fleet characteristics.

26 States are required to inspect all major pollution sources each year. Any violations of permit conditions or regulatory standards must be addressed and corrected. Sources that enjoyed economic benefit due to noncompliance must be penalized an amount equal to the value of the economic benefit plus an amount sufficient to prevent a recurrence. The Clean Air Act authorizes the EPA to assess penalties of up to $37,500 per day per violation. Each state also has its own penalty policy, which is reviewed and approved by the EPA. See also, for example, the EPA's annual compliance and enforcement reports; the 2011 report can be found at http://www.epa.gov/compliance/resources/reports/endofyear/eoy2011/index.html

Figure 4

Illustration of an Integrated Modeling Framework [27]



- **Quantifiable:** Calculation methodologies must be acceptable, transparent, and replicable, and the raw data required to verify the calculations must be available.
- **Enforceable:** State and/or federal authorities must be able to enforce the pollution control measure through legal processes.

Once the modeling of control strategies is completed, formal (i.e., notice and comment) or informal stakeholder processes are often convened to gather feedback from industry representatives, the public, non-governmental organizations, experts, and others on the package of regulations that are proposed in the SIP. Similar processes for nonattainment areas that cross state boundaries are often convened by councils of governments or as part of other multi-state, multi-agency planning processes. The EPA itself often participates in these processes, either directly to comment, or to assist and offer advice.

Several months to a year may be required to develop the SIP regulations to address nonattainment. Many states also require legislative approval before the state can submit the regulations to the EPA. A complete, approvable SIP is extensive; it includes information about emission inventories, monitoring networks, air quality analyses, modeling assumptions and results, attainment demonstrations, enforcement mechanisms, and the adopted regulations. The finished SIP is submitted to the EPA for approval, revision, or rejection. The EPA's review and approval process also can be quite lengthy.

A complete, approvable SIP includes information about emission inventories, monitoring networks, air quality analyses, modeling assumptions and results, attainment demonstrations, enforcement mechanisms, and the adopted regulations.

Although the states and localities are normally responsible for enforcing the requirements of the SIP, the EPA can also enforce them. This is because the underlying statutory authority for these rules is the federal Clean Air Act. Although it is delegated to states initially, the EPA bears ultimate responsibility for achieving its purposes and, if necessary, enforcing its requirements. Although infrequent, the EPA can initiate enforcement actions against entities that violate regulations or requirements in state SIPs and has done so on occasion. If a state or locality refuses to develop and implement an approvable SIP to address nonattainment, the EPA has the

27 Colburn, 2004

authority and responsibility to develop and implement its own Federal Implementation Plan (FIP) instead, or to impose sanctions including withholding of federal highway funds.

Other remedies exist for cases in which a downwind state is affected by pollution emitted in and then transported from another, upwind state by prevailing winds. The Clean Air Act provides that states affected by transported pollution may petition the EPA to compel the upwind state (or states) to reduce its emissions. Once submitted, the EPA has 60 days to take action on the petition. If the EPA agrees with the state's petition, the EPA will impose federal conditions on the upwind state. These federal conditions will remain in effect unless and until the upwind state revises its SIP or develops a new SIP incorporating state regulations that reduce pollutant emissions enough to minimize their impact on air quality in the downwind state. Because the attainment status of a state is based on actual measured pollutant concentrations in that state, however (regardless of origin of the pollution), the downwind state may be required to adopt additional control measures as well to assure that its air quality does not degrade. In such circumstances, the downwind state may impose additional control requirements on power plants, and, depending on that state's regulatory procedures, the utilities that own or operate the affected power plants may request cost-recovery of their pollution control expenses.

SIPs and their supporting documents must also demonstrate continuous improvement in reducing pollution and progressing toward attainment. In conjunction with the EPA, states must assess the efficacy of their control measures through regular "Rate of Progress" (ROP) and/or "Reasonable Further Progress" (RFP) determinations. These processes essentially compare emissions reductions and air quality improvement to the amount of time remaining until the required attainment date. Nonattainment areas that are running "behind schedule" may be required to adopt additional control measures.[28] Nonattainment areas that do not attain the NAAQS by the required date must submit a new SIP revision for EPA approval, including additional measures as the EPA may require. Their nonattainment severity classification may also be "bumped up," and the EPA may then issue a new, later attainment date.

The degree to which a single source may degrade the air depends upon the influence the source will have on the surrounding areas and the NAAQS classifications of those areas.

SIPs are not static documents; they are continually being re-evaluated and revised. Pollution levels in local areas periodically change, regulations as implemented may turn out to be more or less effective than expected, population growth and economic activity levels change and create corresponding changes in air pollution, so SIPs are often adjusted to maintain their course toward achieving attainment. Additionally, improved scientific understanding may lead the EPA to issue a SIP call requiring one or more states to adopt additional control measures to reduce local air pollution or emissions transported to downwind jurisdictions.

In addition to NAAQS, there are many other requirements and provisions of the Clean Air Act. Many of these other provisions, described below, also are incorporated into state SIPs.

- **Prevention of Significant Deterioration (PSD).** This permitting program applies to the construction or modification of major sources in areas that attain the NAAQS. The degree to which a single source may degrade the air depends upon the influence the source will have on the surrounding areas and the NAAQS classifications of those areas. The incremental degradation allowed by a single source is much less if it impacts a national park or wilderness area than for other areas that meet the NAAQS. Sources in nonattainment areas for ozone must still do PSD for all other pollutants, including NO_X, which is both a precursor to ozone and a criteria pollutant. States are required to prepare SIPs under this program, and can also operate a federally delegated PSD program.

- **New Source Performance Standards.** These standards require that new or modified major industrial sources of emissions must be equipped with the "best system" of emissions control available. Such standards have been developed for many types of facilities, including electric generating units, primary

28 Typically states are required to demonstrate that emissions of the subject pollutant decline at a rate equal to or greater than three percent per year.

metal production facilities, oil refineries, cement manufacturing plants, and large industrial boilers. A current question is whether energy efficiency measures might qualify as the "best system" for NSPS purposes. Also, as counterintuitive as it may sound, the EPA has the authority to promulgate NSPS standards for *existing* sources as well (i.e., not only new sources) when a pollutant is not regulated as a HAP or subject to an NAAQS.[29]

- **New Source Review (NSR).** This program establishes additional permitting requirements for new "major sources" of air pollution in nonattainment areas under the NAAQS. NSR requirements also apply to major modifications to existing facilities. New sources (or major modifications) can be allowed in nonattainment areas if (1) "offsetting" emissions reductions are obtained from existing sources in the same area (at a ratio based on nonattainment severity but typically greater than 1:1), and (2) the source is equipped with stringent technology-based controls that represent the "lowest achievable emission rate" (LAER). The rationale for this program lies in the relative ease of controlling emissions from new facilities, and the "grandfathering" of older facilities with high emission rates under the Clean Air Act. To dissuade sources from simply upgrading older, "grandfathered" facilities in order to avoid LAER requirements, the Act purposefully applied NSR and PSD requirements to major modifications of existing facilities. This has led to contentious debates about whether the Act effectively discourages plant upgrades that would result in cleaner, more efficient operations, but which fall short of LAER. It has also led to numerous enforcement actions and resulting legal challenges about exactly what comprises a major modification.

- **National Emission Standards for Hazardous Air Pollutants.** Covered industrial facilities emitting toxic air pollutants must be equipped with "Maximum Available Control Technology" (MACT) to reduce these emissions. For new sources, MACT reflects the best performing single similar facility in existence in the United States or elsewhere. For existing facilities, MACT requires emissions control technology reflecting the average emission reduction performance of the best performing 12% of facilities in the same industrial category. This is the program under which the EPA promulgated the MATS rule requiring reductions in mercury emissions from power plants.

- **The Acid Rain Control program.** This program capped the total amount of emissions of SO_2 from all large electric generating units, new and existing, and allocated emissions "allowances" – for free – to sources based on their historical emissions. Each allowance is equivalent to the emission of one ton of SO_2. Sources covered by the program could then buy or sell allowances. This enabled greater reductions to be achieved at the more cost-effective facilities, which could then sell their extra allowances – in an open market – to facilities where emission controls would be more expensive to install. This program provided the first large-scale, successful, commercial test of the market-based concept known as "cap-and-trade." NO_X emissions can also contribute to acid rain; the Acid Rain Program did not set a cap on NO_X emissions, but instead set emission rate limitations for coal-fired units and allowed utilities to develop more flexible system-wide compliance strategies.[30]

- **Emissions limitations associated with other Clean Air Act programs may also affect power sector sources.** Specifically, the Regional Haze program, which seeks to preserve and improve visibility in the nation's "airsheds," may require "best available retrofit technology" (BART) for SO_2 and/or NO_X emissions from existing sources. Although excessive ozone and particulate matter are the predominant causes of nonattainment, in some circumstances ambient levels of SO_2, NO_X, CO, or other criteria pollutants may also lead to an area being designated as nonattainment.

29 Notably for total reduced sulfur emissions from pulp and paper mills, municipal waste combustor emissions, and most recently, for GHG emissions from power plants.

30 U.S. Environmental Protection Agency, year unknown A

The SIP process is one of the principal air quality management tools in the United States, and it reflects an effective balancing of national, state, and local interests in improving and maintaining air quality protective of the public's health and welfare. The SIP process creates an effective partnership between state and federal governments and allows tailor-made emission reduction programs to be developed for individual jurisdictions. The SIP process has also created a uniform methodology of measuring emissions across the United States, along with sophisticated models for linking emissions with air quality. Perhaps most important, the SIP process has worked: criteria pollutant emissions have decreased,[31] air quality has improved, and many areas of the United States have attained the NAAQS.

However, the SIP process is also enormously resource-intensive for state and local agencies as well as for the EPA. Appropriate concerns about the need to improve the SIP process – both technically and in terms of its resource requirements – have been raised. The National Research Council's comprehensive 2004 report offers an accurate overview:

> *The SIP process is an important and essential component of the nation's air quality management system. It allows state and local agencies to take into account emission controls adopted at the federal and multistate levels and then choose a suitable suite of additional local emission-control measures to reach attainment. On balance, this process should provide an appropriate division of responsibility. It can also provide the basis for a constructive partnership between the federal and state governments that steadily improves air quality on the local, multistate, and national levels. Air quality monitoring data confirm that such improvements have occurred in the past two decades. Nevertheless, important adjustments to the SIP process are needed if the difficult challenges ahead are to be effectively addressed.*[32]

Specific criticisms of the SIP process as it is currently implemented include that it:

- Is overly bureaucratic, time consuming, and complicated, and focuses primarily on compliance with process steps;
- Overemphasizes attainment demonstrations as opposed to tracking and measuring actual progress and performance more frequently;

The SIP process has worked: criteria pollutant emissions have decreased, air quality has improved, and many areas of the United States have attained the NAAQS. However, the SIP process is also enormously resource-intensive for state and local agencies as well as for the EPA. Appropriate concerns about the need to improve the SIP process — both technically and in terms of its resource requirements — have been raised.

- Takes a single-pollutant focus instead of a more cost-effective and synergistic multi-pollutant focus;
- Lacks adequate mechanisms for addressing multi-state air pollution problems; and
- Fails to achieve attainment of ozone and particulate matter NAAQS in many areas.[33]

In addition, as one might expect in methods developed nearly a quarter century ago, the SIP process has not been ideally amenable to changing technologies and innovative practices. For the purposes of this paper, examples include difficulties in readily incorporating and crediting output-based regulatory approaches to electric generation, renewable energy, distributed generation, and energy efficiency. Some of these difficulties relate to uncertainties in quantification, permanence, enforceability, and precisely where the resulting reductions in generation (and associated emissions) occur. These are not trivial concerns, but the SIP process must be made amenable to the economic, public health, energy, and environmental benefits that these measures can provide.

Although the SIP process is resource-intensive, it has provided a major impetus for the development of state air pollution monitoring and control efforts. States have found the process arduous, but the relative flexibility that SIPs provide enables states to tailor – to some degree – which categories of sources and what level of emission reductions will be targeted in the control measures that

31 NO_X emissions from power plants have decreased by 33% since 1990 and SO_2 emissions have decreased by 41% since 1980. U.S. Environmental Protection Agency Clean Air Markets Program, year unknown C

32 National Research Council, 2004, 128

33 National Research Council, 2004

the state adopts to meet air quality requirements. This is difficult and challenging, but provides more options than the alternative: "command and control" dictates from the federal government. In addition, the funding and other resources that the EPA provides to support air quality monitoring, planning, and enforcement are important benefits for states. A few states routinely convene meetings between their air quality agencies and PUCs to discuss air quality planning as it relates to energy issues. These informal meetings allow PUC staff to provide input to the air regulator and also help inform the Commission about areas in which it may need to get involved or provide advance notice about future regulatory proceedings. Such informal meetings are not mandated by the Clean Air Act, but states that use them have found them very helpful for both energy and air quality planning purposes. Sharing issues, developments, and strategies also provides both agencies greater opportunity to prepare for and most effectively address the energy or economic aspects of air quality requirements – or the air quality impacts of upcoming utility or Commission decisions. Further, it helps to assure that both air quality and energy regulators are receiving the same information from affected utilities.

Effectiveness of the Federal Clean Air Act

Developing and implementing SIPs can be challenging and onerous for states, and somewhat risky due to their federal enforceability. Few states, however, would forego the opportunity SIPs provide to tailor Clean Air Act regulatory programs to individual state circumstances. And although the costs of the SIP program and other Clean Air Act provisions are high, the benefits of the Act over the past 40 years far outweigh its costs. The Clean Air Act amendments of 1990 prevented more than 160,000 premature deaths in 2010, and this number is expected to increase to 230,000 by 2020.[34] The costs of meeting all the 1990 Clean Air Act provisions in 2020 are estimated to be $65 billion, whereas the benefits from reduced death and illness, improved economic welfare, and better environmental conditions are estimated to be almost $2 trillion by 2020.[35] Analyses of the costs and benefits of federal regulations by the White House Office of Management and Budget (OMB) – under both Republican[36] and Democratic[37] Administrations alike – consistently suggest that of the total benefits of major federal regulations adopted by all federal agencies, about 80% are attributable to the Clean Air Act compared to only about 50% of the costs. Further, economic indicators appear to contradict assertions that the Clean Air Act has impaired the economy. As Figure 5 illustrates, emissions of the six criteria pollutants together have fallen by 63% since 1970, while private sector jobs increased by 86%, GDP

34 U.S. Environmental Protection Agency, year unknown B

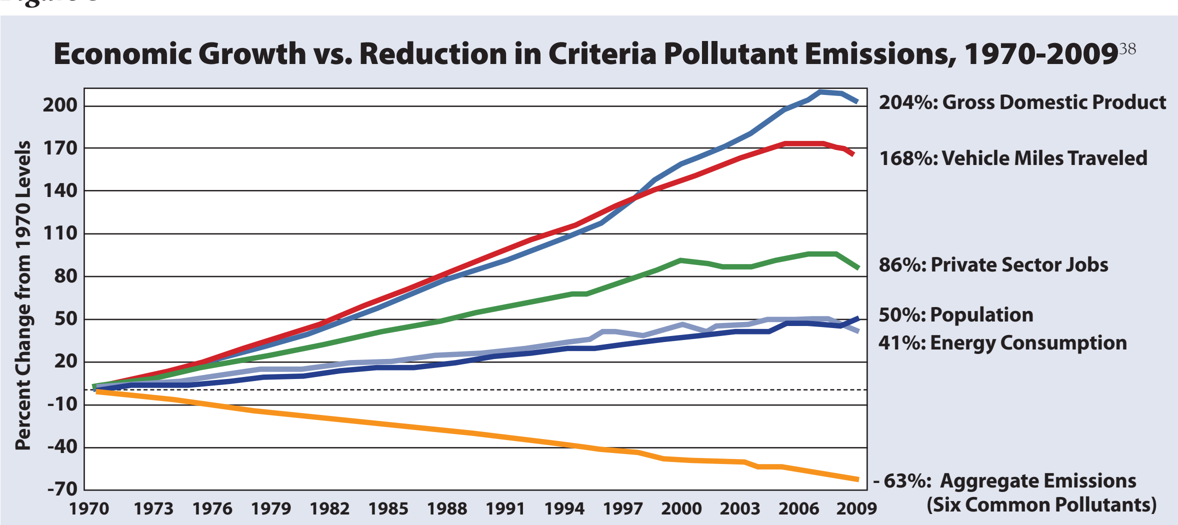
35 U.S. Environmental Protection Agency, 2011

36 U.S. Office of Management and Budget, 2008. This analysis by President Bush's OMB of major federal regulations adopted 1997-2007, listed the EPA Office of Air benefits at $79-573 billion against total benefits of $122-656 billion and costs of $26-29 billion against total costs of $46-54 billion.

37 U.S. Office of Management and Budget, 2011. This analysis by President Obama's OMB of major federal regulations adopted 2000-2010, listed the EPA Office of Air benefits at $77-535 billion against total benefits of $132-655 billion and costs of $19-24 billion against total costs of $44-62 billion.

38 U.S. Environmental Protection Agency, 2011

Figure 5



grew by 204%, and population, energy consumption, and vehicle miles traveled all increased markedly.

Air Quality Management Plans: Moving Beyond SIPs

The accomplishments of the Clean Air Act are truly noteworthy. Nevertheless, as noted above, it has significant room for improvement in light of current knowledge, a fact that is unsurprising given that Congress last reauthorized the Act over two decades ago. In the case of SIPs specifically, the process is time-consuming and complicated; it may not be optimally effective at reducing multiple pollutants; and it requires states to focus narrowly on one criteria pollutant at a time. The comprehensive 2004 NRC report recommended numerous improvements, but few have yet been adopted by Congress or the EPA. Accordingly, some jurisdictions are moving forward on their own and have – through their actions – begun to consider how the SIP process might be transformed into a more performance-oriented, multi-pollutant air quality management planning process. The *2010 Clean Air Plan* of the Bay Area Air Quality Management District in San Francisco, California is a good example of movement in this direction.[39] The first comprehensive multi-pollutant clean air plan of its kind in the United States, this plan applies to all pollutants, including criteria, toxic, and GHG emissions. It includes 55 control measures across stationary sources, mobile sources, transportation, land-use, and energy/climate sectors, many of which are designed to address the root causes of emissions, not just end-of-pipe emission controls.[40] New York State also has a concerted multi-pollutant planning effort underway. Working with the New York State Energy Research & Development Authority (NYSERDA), the Department of Environmental Conservation is developing an Air Quality Management Plan that addresses air quality concerns, including nonattainment and maintenance of criteria pollutant NAAQS, sector-based emission control strategies, emission and risk reductions of HAPs, climate change, and regional haze and visibility. To the extent practicable, it will also include such considerations as environmental justice, land use, transportation, energy, and ecosystem health.[41]

Ideally air quality management planning should seek to integrate all or most pollutants and air quality measures and activities into a single, internally consistent, cost-effective approach to improving air quality, public health, and welfare. This approach offers economies of scale, because most air pollutants come from similar sources and precursors, and strategies for controlling them are often similar. In addition, comprehensive air quality management planning can address problems caused by multiple air pollutants at the same time and interrelationships among pollutants, offering a pollution control framework that operates with internal consistency, rather than sometimes at cross-purposes. Comprehensive air quality management planning would encompass measures to mitigate criteria pollutants, hazardous air pollutants, and GHGs as required by federal law, as well as any more stringent standards or goals that may be set by the individual state. As suggested throughout this paper, however, comprehensive air quality planning that integrates multiple pollutants is only half the answer; comprehensive integration of energy planning and air quality planning is ultimately essential for the development of reliable, affordable, clean energy solutions.

Comprehensive air quality planning that integrates multiple pollutants is only half the answer; comprehensive integration of energy planning and air quality planning is ultimately essential for the development of reliable, affordable, clean energy solutions.

Although a comprehensive discussion about the process, benefits, costs, and issues associated with developing and implementing comprehensive air quality management planning in concert with state energy planning is beyond the scope of this paper, this approach promises to provide increased opportunity for cooperation and collaboration, because state energy agencies have substantial experience with least-cost integrated resource planning to share.

39 The full plan and executive summary are available at http://www.baaqmd.gov/Divisions/Planning-and-Research/Plans/Clean-Air-Plans.aspx

40 James & Schultz, 2011

41 Bielawa, 2011

Conclusion

Our nation's electricity system faces multiple urgent challenges to address mounting transmission needs, to install and adapt to smart grid technologies, to expand the use of renewable energy, to capture unprecedented energy efficiency opportunity, and to meet increasingly stringent environmental requirements. Air quality management in the United States faces equally daunting challenges imposed by science-based mandates for greater health and environmental protection, diminishing state and federal budgetary support, and clear signs of aging in traditional "stovepiped" regulatory approaches. At the same time, half of all U.S. citizens still breathe unhealthy air by virtue of living in a nonattainment area for at least one pollutant,[42] and America's near century-long global economic leadership is today in jeopardy.

Half of all U.S. citizens still breathe unhealthy air by virtue of living in a nonattainment area for at least one pollutant.

In this context, conflict between appropriate health and environmental protections on one hand and a reliable electricity supply on the other is simply untenable; they cannot continue to be each other's worst obstacle. Rather than remain caught in a vicious cycle of increasing emissions, environmental regulations, costs, and reliability impacts, energy and air regulators have the opportunity to create a "virtuous cycle" if they choose to engage jointly in creating reliable, affordable, clean energy solutions. This essential outcome will not happen until energy and air quality regulators affirmatively decide to work closely together, and understand what motivates each agency and how they each conduct their work.

For energy regulators and staff – the intended audience for this paper – such understanding begins with an appreciation of the federal Clean Air Act's provisions regarding NAAQS and SIPs. Arguably the most complex piece of environmental legislation ever passed, the Clean Air Act requires that the EPA establish health-based NAAQS without regard to costs. States must achieve those standards by a date certain or face serious sanctions. To meet this bar, state air officials with nonattainment areas enjoy some flexibility but face absolute accountability for identifying, developing, and implementing a comprehensive, multi-sector suite of measures to reduce pollutant emissions enough to reach attainment: the SIP. Following their exhaustive development, SIPs must also be approved by the EPA, and once the Agency does so, it is empowered to enforce the state programs and provisions within the SIP.

Further, just as state energy regulators face a continuing challenge to determine precisely what is "just and reasonable," "used and useful," or "prudent" in today's technologically, economically, and politically disruptive era, state air quality officials also face a moving target as the EPA – again adhering to Clean Air Act directives – periodically reviews and modifies NAAQS to incorporate new scientific and medical evidence. For state air officials, such NAAQS revisions create the risk of new nonattainment areas, a worsening of existing nonattainment area classifications, or both.

The Clean Air Act has certainly been successful; aggregate air pollutant emissions are down dramatically since its passage, despite significant increases in GDP, population, energy consumption, and jobs. The Act is credited with a disproportionate share of the benefits of all federal regulations from all agencies, benefits that far outnumber its costs.

The latest reauthorization of the Clean Air Act is now over 20 years old, however, and is showing signs of age. It doesn't encourage innovation or enable cost-effective multi-pollutant emission reduction approaches, for instance, nor does it satisfactorily address multi-state

42 U.S. Environmental Protection Agency, 2012a. The EPA's report indicates 154,454,000 people live in an area that is in nonattainment for at least one of the NAAQS; the U.S. Census Bureau indicates that the United States population as of July 2011 was 311,591,917.

air pollution issues. Its requirements are often overly bureaucratic and prescriptive. The last amendments to the Act occurred prior to electricity restructuring, and its framers did not contemplate distributed generation, demand response, renewable portfolio standards, the electrification of transportation, or the disruptive technologies now in development. Some states are moving ahead on their own to adopt air quality planning approaches that include multiple pollutants, multiple states, and even multiple agencies – specifically energy and air quality authorities.

Rather than remain caught in a vicious cycle of increasing emissions, environmental regulations, costs, and reliability impacts, energy and air regulators have the opportunity to create a "virtuous cycle" if they choose to engage jointly in creating reliable, affordable, clean energy solutions.

The public demands reliable, affordable, clean energy solutions. By understanding the obligations, structure, and processes in which each agency acts, and working closely and purposefully to simultaneously meet state energy and air quality goals, energy and air quality regulators can best satisfy the public's interest. If energy regulators choose not to engage with their air quality counterparts in this quest, air regulators will be left with only those solutions under their control, which are reasonably likely to favor end-of-pipe options costing far more than solutions that are available under the PUCs' control. Air officials, of course, have a similar obligation to engage with the PUCs. By jointly answering the call to action for least-cost air quality compliance, air quality and energy regulators may well create a template for future improvements to the Clean Air Act.

Appendix A

Required SIP Elements for Certain NAAQS[43]

Acronyms used to describe the required SIP elements below include:

- **CTG** – control technique guidelines
- **I/M** – inspection and maintenance (motor vehicle tailpipe testing)
- **NO_X** – oxides of nitrogen
- **NSR** – new source review
- **PSD** – prevention of significant deterioration
- **RACM** – reasonably available control measures
- **RACT** – reasonably available control technique
- **RFP** – reasonable further progress
- **TCMs** – transportation control measures
- **VMT** – vehicle miles traveled
- **VOC** – volatile organic compounds

Ozone Requirements for the 1997 8-hour Ozone Standard Nonattainment Areas and the Northeast Ozone Transport Region

The required SIP elements tracked for the 1997 8-hour ozone standard are:

- Ozone Attainment Demonstration (including emissions limits and other control measures adopted by the state)
- RFP (VOC and NO_X) for current classification
- Emissions Inventory
- Clean Fuels for Fleets
- Contingency Measures (VOC and NO_X)
- Contingency Provisions for RFP Milestones
- Emissions Statement
- Enhanced Monitoring - Photochemical Assessment Monitoring Stations (PAMS)
- I/M Basic
- I/M Enhanced
- Nonattainment NSR program for current classification
- Stage II vehicle refueling vapor recovery or equivalent
- TCMs to Offset Growth
- VMT Demonstrations and TCMs
- Severe/Extreme Area Fee Program
- RACT Non-CTG VOC for Major Sources
- RACT NO_X for Major Sources
- RACT VOC CTG Aerospace
- RACT VOC CTG Bulk Gasoline Plants
- RACT VOC CTG Equipment Leaks from Natural Gas/ Gasoline Processing Plants
- RACT VOC CTG Factory Surface Coating of Flat Wood Paneling
- RACT VOC CTG Fugitive Emissions from Synthetic Organic Chemical Polymer and Resin Manufacturing Equipment
- RACT VOC CTG Graphic Arts - Rotogravure and Flexography
- RACT VOC CTG Large Petroleum Dry Cleaners
- RACT VOC CTG Leaks from Gasoline Tank Trucks and Vapor Collection Systems
- RACT VOC CTG Leaks from Petroleum Refinery Equipment
- RACT VOC CTG Manufacture of High-Density Polyethylene, Polypropylene, and Polystyrene Resins
- RACT VOC CTG Manufacture of Pneumatic Rubber Tires
- RACT VOC CTG Manufacture of Synthesized Pharmaceutical Products
- RACT VOC CTG Petroleum Liquid Storage in External Floating Roof Tanks
- RACT VOC CTG Refinery Vacuum Producing Systems, Wastewater Separators, and Process Unit Turnarounds
- RACT VOC CTG Shipbuilding/repair

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- RACT VOC CTG SOCMI Air Oxidation Processes
- RACT VOC CTG SOCMI Distillation and Reactor Processes
- RACT VOC CTG Solvent Metal Cleaning
- RACT VOC CTG Stage I Vapor Control Systems - Gasoline Service Stations
- RACT VOC CTG Storage of Petroleum Liquids in Fixed Roof Tanks
- RACT VOC CTG Surface Coating for Insulation of Magnet Wire
- RACT VOC CTG Surface Coating of Automobiles and Light-Duty Trucks
- RACT VOC CTG Surface Coating of Cans
- RACT VOC CTG Surface Coating of Coils
- RACT VOC CTG Surface Coating of Fabrics
- RACT VOC CTG Surface Coating of Large Appliances
- RACT VOC CTG Surface Coating of Metal Furniture
- RACT VOC CTG Surface Coating of Miscellaneous Metal Parts and Products
- RACT VOC CTG Surface Coating of Paper
- RACT VOC CTG Tank Truck Gasoline Loading Terminals
- RACT VOC CTG Use of Cutback Asphalt
- RACT VOC CTG Wood Furniture
- RACT VOC CTG Flat Wood Paneling Coatings (2006)
- RACT VOC CTG Flexible Packaging Printing Materials (2006)
- RACT VOC CTG Industrial Cleaning Solvents (2006)
- RACT VOC CTG Lithographic Printing Materials and Letterpress Printing Materials (2006)
- RACT VOC CTG Large Appliance Coatings (2007)
- RACT VOC CTG Metal Furniture Coatings (2007)
- RACT VOC CTG Paper, Film, and Foil Coatings (2007)
- RACT VOC CTG Miscellaneous Metal Products Coatings (2008)
- RACT VOC CTG Plastic Parts Coatings (2008)
- RACT VOC CTG Auto and Light-Duty Truck Assembly Coatings (2008)
- RACT VOC CTG Fiberglass Boat Manufacturing Materials, and Miscellaneous (2008)
- RACT VOC CTG Industrial Adhesives (2008)

Fine Particulate Matter ($PM_{2.5}$) Nonattainment Area Requirements

The required SIP elements tracked for $PM_{2.5}$ nonattainment areas are:

- $PM_{2.5}$ Attainment Demonstration
- $PM_{2.5}$ Contingency Measures
- $PM_{2.5}$ Nonattainment Area NSR Program
- $PM_{2.5}$ RACM/RACT
- $PM_{2.5}$ RFP
- Emissions Inventory

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Acronyms

ASAI	Average Service Availability Index
BART	Best Available Retrofit Technology
CAIDI	Customer Average Interruption Duration Index
CAIFI	Customer Average Interruption Frequency Index
CIII	Customers Interrupted per Interruption Index
CMSA	Consolidated Metropolitan Statistical Area
CO	Carbon Monoxide
CSAPR	Cross-State Air Pollution Rule
EPA	Environmental Protection Agency
FIP	Federal Implementation Plan
GHG	Greenhouse Gas
HAPs	Hazardous Air Pollutants
IEEE	Institute of Electrical and Electronic Engineer
LAER	Lowest Achievable Emission Rate
MACT	Maximum Available Control Technology
MATS	Mercury and Air Toxics Standards
MSA	Metropolitan Statistical Area
NAAQS	National Ambient Air Quality Standards
NESHAP	National Emission Standards for Hazardous Air Pollutants
NO_x	Nitrogen Oxides
NO_2	Nitrogen Dioxide
NSPS	New Source Performance Standards
NSR	New Source Review
NYSERDA	New York State Energy Research & Development Authority
OAQPS	Office of Air Quality Planning and Standards
OECA	Office of Enforcement and Compliance Assurance
OMB	Office of Management and Budget (White House)
O_3	Ozone
Pb	Lead
PBT	Persistent bioaccumulative toxin
ppb	Parts per billion
ppm	Parts per million
PSD	Prevention of Significant Deterioration
PUC	Public Utility Commission
RFP	Reasonable Further Progress
ROP	Rate of Progress
SAIDI	System Average Interruption Duration Index
SAIFI	System Average Interruption Frequency Index
SIP	State Implementation Plan
SO_2	Sulfur Dioxide
TIPs	Tribal Implementation Plans
VOC	Volatile Organic Compound

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