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Pollution Cap and Trade Programs in Kentucky

Research Report No. 343

Prepared by

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Pollution Cap and Trade Programs in Kentucky

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Impact Plus, Report 300, 2001

Kentucky Housing Corporation Allocation of Federal Homeless Grant Money, Report 291, 2000

Progress Report on Coordinated Human Service Transportation System, Report 298, 1999

Personnel Pilot Projects: Design Weakness Limits Effectiveness, Report 295, 1999

Kentucky Early Intervention System - First Steps, Report 293, 1999

Health Insurance Market for Employees and Retirees of Kentucky State Government, Report 286, 1999

State Agency Service Contract Administration, Report 285, 1999

Review of the Kentucky Children's Health Insurance Program, Report 283, 1999

Motor Vehicle Registration Abuse, Report 282, 1999

Kentucky Medicaid Drug File and Prior Authorization System, Report 281, 1999

Division of Licensing and Regulation, Cabinet for Health Services, Office of Inspector General, Report 279, 1997

State Park Marinas, Report 278, 1997

Department for Social Insurance Eligibility Determination Process, Report 277, 1996

Cabinet for Human Resources Family Service Workers' Caseloads, Report 275, 1996

Kentucky Medical Assistance Program, Report 274, 1996

Kentucky Association of Counties Self-Insurance and Loan Programs, Report 271, 1994

Kentucky's State Park System, Report 269, 1994

Kentucky Department for the Blind Interstate Vending Program, Report 268, 1994

Kentucky's Unified Juvenile Code, Report 265, 1993

Out-of-Home Child Care in Kentucky, Report 263, 1993

Foreword

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Contents

List of Tables

List of Figures

Summary

The adoption of cap and trade programs to reduce pollution represented a change in how governments addressed environmental policy. In the past, governments typically imposed specific limits on the amount of pollution that each individual source of pollution could produce. Cap and trade programs were adopted as a way to provide the owners of the sources of pollution a way to reduce emissions at lower costs. Under a cap and trade program, the government sets a total limit on the amount of a pollutant that sources can emit as a group. The government then issues allowances to the sources. Each allowance represents a certain amount of the pollution and may be bought and sold. At the end of a period, each source must surrender a sufficient number of allowances to cover its emissions for the period. If a source cannot provide a sufficient number of allowances, the government may impose various penalties.

For a given level of emissions, cap and trade programs can give firms the flexibility and incentive to find lower-cost methods of achieving the reduction. A firm that can reduce its emissions at a lower cost has an incentive to do so and then sell its allowances to a firm that has a higher cost of reducing emissions. This transaction allows both firms to reduce emissions at a lower total cost than they could without trade.

The manner in which allowances are allocated determines how the benefits of allowances are distributed. States have little control over how sulfur dioxide allowances are distributed, but they have greater control over how nitrogen oxide allowances are allocated. Different allocation methods will largely result in shifting the benefits associated with allowances from one group of the population to another.

Chapter 1
Introduction and Legal Framework

There are two primary cap and trade programs that affect sources located in Kentucky. One program covers sulfur dioxide (SO_2) and the other program covers nitrogen oxides (NO_x). Sulfur dioxide is emitted when fossil fuels are burned and when gasoline is produced. SO_2 contributes to acid rain and has been linked to a number of health concerns such as heart and lung disease. Nitrogen oxides are also produced when fossil fuels are burned. NO_x contributes to the formation of ground-level ozone, which can lead to health problems and environmental damage. In addition to the major federal programs, there are also local programs to reduce pollutants that operate similarly to cap and trade programs.

To address concerns over acid rain, Congress amended the Clean Air Act to require limits on the amount of SO_2 that certain electric generating units could produce. The restrictions were phased in from 1995 through 2000 and eventually included nearly all electric generating units that could produce 25 or more megawatts of electricity.

As one option for administering the limitations, the Environmental Protection Agency (EPA) developed the Acid Rain Program, which included tradable allowances and a cap on the amount of SO_2 that units could produce. Each allowance represents one ton of SO_2 emissions. The allowances are distributed each year by EPA directly to the affected units. States were not required to participate in the Acid Rain Program. Each state had the option of developing its own strategies to reduce SO_2 emissions. States choosing to participate in the program, however, were subject to EPA's allocation methods and could not develop a different plan to allocate allowances.

In 2005, EPA issued the Clean Air Interstate Rule (CAIR) to address the formation of ground-level ozone that is blown across state boundaries. CAIR included additional restrictions on the amount of SO_2 that units in 25 states, including Kentucky, and the District of Columbia could produce. The additional restrictions will operate in conjunction with the existing Acid Rain Program. An electric generating unit affected by CAIR will be required to submit a greater number of allowances for each ton of SO_2 it produces.

EPA also published regulations requiring states to reduce the amount of NO_x emitted from certain sources. The initial regulations were issued in 1998 and were designed to reduce the amount of NO_x transported across states from May 1 through September 30 of each year. This period of the year is referred to as the ozone season because it is when NO_x emissions peak. These regulations covered electric generating units and large industrial units that produce electricity.

As one option for reducing NO_x emissions, EPA developed the NO_x Budget Trading Program. Under this program, EPA allocates a certain number of allowances to each state for its affected units. States are responsible for allocating NO_x allowances and have some flexibility in how allowances are distributed. Currently, Kentucky distributes 98 percent of allowances to existing sources of NO_x emissions within the state. The remaining 2 percent are sold.

CAIR also requires additional reductions in the amount of NO_x that can be emitted from certain sources in 25 eastern states, including Kentucky. The limit on NO_x emissions will be lowered for 2009 through 2014 and then lowered again in 2015. Under CAIR, there will be two trading programs: an ozone season and an annual program. A source emitting NO_x will have to hold a sufficient number of allowances under each program. As with the NO_x Budget Trading Program, states have some flexibility in how allowances will be distributed.

Congress also mandated that EPA establish standards for several types of air pollution and requires that each state monitor its air quality relative to these standards. Areas not meeting a standard are classified as being in nonattainment for the standard. State and local officials must develop plans for improving the air quality within these nonattainment areas. Kentucky has seven counties that are classified as being in nonattainment for ozone: Boone, Boyd, Bullitt, Campbell, Jefferson, Kenton, and Oldham. Seven counties are classified as being in nonattainment for PM-2.5: Boone,

Boyd, Bullitt, Campbell, Jefferson, Kenton, and Lawrence. PM-2.5 refers to particulate matter that measures less than 2.5 micrometers in diameter.

One federal requirement to reduce pollution in nonattainment areas is that any increase in emissions from a new or modified stationary source be offset by a corresponding reduction in emissions by existing sources. In Louisville, the offset requirements for volatile organic compounds are administered through a program of emission reduction credits, which operates similarly to a cap and trade program. A firm owning an existing stationary source of these compounds can receive credits by reducing its emissions below its required level. These credits can then be used by the firm to offset an increase from another source it owns within Louisville or sold to another firm.

Chapter 2
Description of Emissions Trading Market

The prices of SO_2 and NO_x allowances have generally been decreasing recently. SO_2 allowance prices have been relatively stable but increased rapidly in 2004 and 2005 as firms were expecting additional environmental restrictions from CAIR. In 2006, SO_2 allowance prices declined. While there has been some variation in recent years, NO_x allowance prices have generally declined in recent years. Some NO_x allowances sold at prices above $7,000 per allowance in 2003. By 2006, NO_x allowances were selling at approximately $700 per allowance.

A firm holding an allowance benefits because the allowance provides an alternative to installing costly equipment to reduce emissions. The manner in which allowances are allocated determines how these benefits are distributed. Two methods of allocation discussed commonly in the research literature are distributing allowances at no charge and selling allowances.

In some instances, the benefits of the allowances may be received by the firm. Firms receiving allowances at no charge would have a cost advantage over those that had to pay for allowances. In other instances, the benefits might be passed on to the firms' customers in the form of lower prices.

Kentucky distributes the majority of its allowances to the owners of electric generating units at no charge. Many of these units are regulated by the Kentucky Public Service Commission, which is responsible for ensuring that the rates charged by the state's utilities are reasonable. It reviews each utility's costs and if the costs are deemed appropriate, allows the utility to pass these costs on to its customers in the form of higher rates. Without the free allocation of allowances, a utility would likely have to purchase allowances to cover its emissions or install equipment to reduce its emissions in order to comply with the environmental regulations. Much of the cost associated with this compliance would likely be passed on to the utility's customers.

If allowances are sold rather than given, the utilities might have to increase their rates, but the state would collect additional revenues. Ultimately, how the additional revenues are used would determine who would benefit from selling all the allowances.

There have been a number of research studies that have examined the cost of reducing pollution under a cap and trade program. The cost savings vary considerably depending on how costs are examined but generally show that costs are lower under cap and trade programs than without trading.

The restrictions that apply to nonattainment areas, such as Louisville, can potentially limit the types of economic growth that occur. These restrictions often impose certain requirements that can have an additional cost to firms locating in the area. As a result, a firm that emits pollution as a part of its production process might find locating in a nonattainment area more costly than locating in other areas.

The system of emission reduction credits for volatile organic compounds can potentially provide some additional flexibility for firms that might locate in Louisville. Under this system of tradable credits, a firm that can reduce emissions would have an incentive to do so if the credits can be sold for a price that exceeds the costs of reducing emissions. While this system provides additional flexibility, it appears that there have been no new firms locating in the city and no expansions that would require the use of credits.

Chapter 1

Overview and Legal Framework

Introduction

Under cap and trade programs, a cap is imposed on the total emissions for a type of pollution. Allowances are granted to pollution sources for specified amounts of emissions. Because allowances can be bought and sold, pollution sources that can reduce emissions at a lower cost can do so and sell allowances to polluters that have higher costs for reducing emissions.

Until 1990, most major environmental policies addressed pollution by requiring specific restrictions on the amount of pollution that various firms could emit. Some criticized these types of policies because they did not address differences in the cost of compliance across different sources of pollution. They argued that pollution could be lowered by similar amounts but at lower costs by imposing a cap on pollution emissions, issuing allowances to emitters, and allowing emitters to trade these allowances. Permitting firms to buy and sell allowances provides firms that can reduce emissions at a lower cost with an incentive to do so and then sell the allowances to polluters that face a higher cost of reducing emissions. These types of programs are often referred to as cap and trade programs.

The Clean Air Act Amendments of 1990 created one of the first major cap and trade programs: reducing emissions of sulfur dioxide (SO_2).

According to Schmalensee et al., the Clean Air Act Amendments of 1990 were some of the first major environmental policies to incorporate cap and trade programs. The amendments established a cap on the amount of sulfur dioxide, or SO_2, that may be emitted. Sources of SO_2, such as electric utilities, were allocated a certain number of allowances, which permitted them to emit one ton of sulfur dioxide for each allowance held. Sources could also buy and sell allowances. Since the cap and trade program for SO_2, additional regional cap and trade programs have been created. Some local areas are under additional restrictions for various pollutants. These restrictions often operate similarly to a cap and trade system.

Description of This Study

This report examines how cap and trade programs can affect Kentucky's economy.

The main question addressed in this study is what impact does trading of emissions allowances have on Kentucky's economy. There are important determinants of the economic effect. The first is the method used to allocate emissions allowances to sources of pollution. The second is the degree to which trading may occur.

How This Study Was Conducted

The Program Review and Investigations Committee voted on August 10, 2006, to have staff study the economic impacts of emissions trading. To study this issue, staff reviewed federal and state laws and regulations to determine how emissions trading works. To understand the volume of trading occurring in Kentucky and trends occurring within this market, staff obtained data on the major trading programs. Staff also interviewed representatives of state and local agencies that oversee environmental policy. Finally, staff reviewed the research literature on the effects of cap and trade programs.

Organization of the Report

Chapter 1 summarizes federal laws and regulations and how they contribute to the structure of various cap and trade programs. Chapter 2 deals with the economic implications of those laws and the resulting emissions trading programs. It also discusses issues associated with controlling emissions allowances in some other manner. The report's main findings relate to how different methods of allocating allowances shift the distribution of benefits from one segment of the population to another. As this involves valuing the trade-offs between two different segments of the population, this report does not provide recommendations as to which allocation is appropriate.

Major Conclusions

This report has six major conclusions.

1. Federal law requires reductions in certain air pollutants but does not require that states participate in cap and trade programs. Cap and trade programs, however, likely decrease the costs of compliance.

2. In some cases, a state choosing a cap and trade program is subject to strict guidelines for administering the program. In other cases, states have greater flexibility.

3. If a state does not participate in a cap and trade program, it still must develop a plan to reduce emissions.

1. Federal law mandates that states meet emissions limits on certain air pollutants. There is no mandate that states participate in the cap and trade programs as a means of controlling emissions. Meeting federal emissions requirements through an emissions trading program would likely decrease the costs of compliance.

2. In some cases, if a state chooses to use a cap and trade program, the U.S. Environmental Protection Agency imposes strict guidelines on how the program must be administered. In other cases, in which a state chooses to use a cap and trade program as a mechanism for controlling emissions, the state may exercise considerable flexibility as to how it administers the program.

3. If a state chooses not to participate in a cap and trade program to control emissions, it must still develop a State

Implementation Plan approved by the Environmental Protection Agency. The plan must outline how the state will meet the emissions limits on various air pollutants required by federal law.

4. As a group, sources of SO_2 emissions that are located in Kentucky have generally had to purchase additional SO_2 allowances to cover their emissions.

5. As a group, sources of nitrogen oxides, or NO_x, emissions that are located in Kentucky sold more NO_x allowances than they purchased in 2004 and 2006 and purchased more than they sold in 2005.

6. Allocating emissions allowances in a different manner would result in a redistribution of the value associated with the allowances. Currently, the majority of both SO_2 and NO_x allowances are allocated to electric utilities. There is no charge for most of these allowances. If these utilities had to pay for allowances, the higher costs would be passed onto the electric customers.

4. As a group, sources of SO_2 emissions that are located in Kentucky have generally had to purchase additional SO_2 allowances to cover their emissions.

5. As a group, sources of nitrogen oxide (NO_x) emissions that are located in Kentucky were net exporters of NO_x allowances in some years and net importers in other years.

6. Allocating allowances in a different manner would redistribute the value associated with the allowances.

Description of a General Cap and Trade Program

Past environmental programs would impose specific reductions on the amount of pollution that sources of the pollution could emit.

Early environmental policy often consisted of command and control policies. Under these policies, the government would impose emissions standards for sources of pollution. The costs of complying with the restrictions could vary considerably across emitters.

Cap and trade programs impose a total cap on the amount of a pollutant that sources can emit but does not impose specific limits on each source.

Under a cap and trade policy, the government imposes a total cap on the amount of a pollutant that may be emitted during a given time period. The cap sets limits for the total emissions from all sources rather than specific limits for each source. The method for selecting the cap can vary but is often based on pollution levels that scientific studies have shown are harmful to humans or to the environment.

The government creates allowances to equal the cap. Each allowance represents a specific amount of pollution. The allowances are distributed to the sources of pollution.

Once the cap is set, a governing agency creates allowances in a number equal to the cap. For example, if a national emissions cap is set at 100,000 tons, there might be 100,000 allowances. These allowances are then allocated. Typically, the allowances are allocated to the sources of the pollution at no cost to the sources, but this too can vary. Sources would then be permitted to emit a certain amount of the pollution for each allowance held.

The allowances may be bought or sold on the market to take advantage of differences in the costs of reducing emissions. A firm facing lower costs of reducing emissions would likely reduce its emissions and sell its allowances to a firm with higher costs of emissions. This trade results in lower total compliance costs.

Once allowances are allocated, they can be bought or sold on a market. This trading is intended to take advantage of differences in compliance costs. The utilities may face different costs to reduce emissions due to the design of their electric generating units. For example, some units have been designed to burn different types of coal. An electric utility might be able to switch from a high-sulfur fuel to a low-sulfur fuel to reduce its sulfur emissions. Other units may require the installation of equipment called scrubbers that captures the sulfur emissions in order to reduce emissions. A 1997 report from the U.S. Department of Energy's Energy Information Administration indicates that switching fuel was estimated to cost about $113 per ton of SO_2 removed and installing scrubbers was estimated to cost $322 per ton of SO_2 removed.

As an example of how trading can lower compliance costs, consider two electric utilities, each of which emits 100 tons of some pollutant. Total emissions would be 200 tons. Assume that it costs utility A $100 per ton to reduce emissions of the pollutant. However, it costs utility B $200 per ton to reduce its emissions. If each utility is required to reduce emissions by one ton each without trading, emissions would be reduced to 198 tons and the reduction would cost $300: $100 for utility A and $200 for utility B.

Next consider how these utilities would comply if a total cap was imposed and each utility was given 99 allowances. If utility A sold one allowance to utility B at a price between $100 and $200, both utilities could gain. At a price of $150, for example, utility A would gain $50 (the difference between the selling price and the cost of compliance). Utility B saves $50 (the difference between its cost of compliance and the selling price). Under the cap and trade system, emissions are still reduced to 198 tons: utility A emits 98 ton; utility B emits 100 tons. But the total cost of compliance is $200 rather than $300. The benefits from trading are distributed between the two utilities. The lower cost of compliance is one of the primary benefits cited by proponents of cap and trade systems.

At the end of a specific period, each source of pollution must have enough allowances to cover its emissions.

At the end of a monitoring period, the owner of each source of pollution must have a sufficient number of allowances to cover its actual emissions. If not, penalties may be imposed.

In some cases, allowances can be banked for use at a later date.

Under some cap and trade systems, emitters may "bank" allowances for use at a later date. For example, if an electric utility held 100 allowances but only emitted 90 tons of the pollutant, the remaining 10 allowances might be held for use in the next year. The provisions for banking vary across different cap and trade systems.

Types of Pollutants

Federal, state, and local governments regulate various types of pollutants. The two main pollutants subject to cap and trade programs are sulfur dioxide and nitrogen oxides. In addition, a number of pollutants are subject to certain restrictions that can take on aspects similar to a cap and trade program. The major pollutants that are discussed in this report are described below.

Sulfur Dioxide

Sulfur dioxide is formed when fuel is burned and contributes to various health and environmental problems.

According to the U.S. Environmental Protection Agency (EPA), sulfur dioxide is formed when fuel that contains sulfur is burned and "when gasoline is extracted from oil" ("Sulfur Dioxide (SO_2)"). Coal and oil both contain sulfur. EPA reported that 65 percent of SO_2 is generated by electric utilities. Industrial facilities such as cement kilns and petroleum refineries also release SO_2. The health concerns attributed to SO_2 include respiratory illness, heart disease, and lung disease. The environmental concerns include acid rain, poor visibility, and damage to vegetation. SO_2 is also a building block of particulate matter, which is easily transported by wind.

Nitrogen Oxides

Nitrogen oxides are also formed with fuel is burned and contributes to ground-level ozone. Too much ozone at the ground level can have adverse health effects and can harm the environment.

Nitrogen oxides also form when fuel is burned. According to EPA, motor vehicles are the primary source of NO_x, accounting for 55 percent of the nation's NO_x emissions in 2003 (U.S. Environmental. "NO_x: What"). Electric utilities account for 22 percent of NO_x emissions. NO_x contributes to the formation of acid rain, ground-level ozone, and fine particles (U.S. Environmental. "Health and Environmental Impacts").

Concerns relating to the formation of ground-level ozone are different from concerns relating to the ozone layer. The ozone layer refers to ozone located high within the Earth's atmosphere. This layer blocks ultraviolet B sunlight, which according to EPA "has been linked to development of cataracts...and skin cancer" (U.S. Environmental. "The Plain"). In this case, too little ozone high in the atmosphere is related to health problems.

The concerns with ground-level ozone center on an abundance of ozone near the ground. Too much ozone at the ground level can also lead to health and environmental problems. Sunlight can cause nitrogen oxides and volatile organic compounds to react and form smog, which can contribute to respiratory problems

(U.S. Environmental. "Health and Environmental Impacts"). The regulations relating to NO_x that are discussed in this report are designed to reduce levels of ground-level ozone.

Volatile Organic Compounds

Volatile organic compounds are emitted from a number of chemicals and can also contribute to ground-level ozone.

Volatile organic compounds are certain gases emitted from a number of chemicals such as paints, cleaning supplies, and gasoline (U.S. Environmental. "An Introduction to Indoor Air Quality"). EPA notes that these compounds can contribute to a number of health-related effects including eye, nose, and throat irritation; headaches; and cancer. Volatile organic compounds also contribute to the formation of ground-level ozone (U.S. Environmental. "Enhanced Ozone").

Particulate Matter

Particulate matter (PM) consists of small particles in the air, which can contribute to health problems for those with respiratory or cardiovascular diseases.

Particulate matter (PM) consists of small solid or liquid particles that float in the air (U.S. Environmental. "PM 2.5"). These particulates are often classified based on their diameters, which are measured in micrometers. There are two classes frequently discussed: PM-2.5, which refers to particles measuring less than 2.5 micrometers in diameter; and PM-10, which refers to particles measuring between 2.5 and 10 micrometers in diameter. According to EPA, particulate matter can contribute to health problems for certain populations such as those with respiratory or cardiovascular diseases.

The Clean Air Act and Amendments

The Clean Air Act and its amendments established the major emissions trading programs and gave the U.S. Environmental Protection Agency (EPA) regulatory authority over these programs.

Congress passed the original Clean Air Act in 1963; although, the 1970 Clean Air Act Amendments established the major environmental regulations that are now commonly associated with the Act. The 1970 amendments established standards for various forms of air pollution and included some early versions of cap and trade programs. Federal regulatory authority was placed with the U.S. Environmental Protection Agency in 1971.

Over time, these programs have been modified.

Over the years, the Clean Air Act has been amended to modify standards and develop new programs for controlling pollution. In addition, EPA revised some of the rules for compliance with the Clean Air Act. Two important rules that established or modified cap and trade programs are the 1998 NO_x State Implementation Plan (SIP) Call and the Clean Air Interstate Rule (CAIR). The NO_x SIP Call led to the NO_x Budget Trading Program, which was first

enforced in Kentucky in 2004. CAIR, finalized in 2005, will place greater restrictions on NO_x and SO_2 emissions.

The following sections discuss the major provisions of the Clean Air Act, its amendments, and EPA regulations that are related to cap and trade type programs. In addition, changes resulting from the adoption of CAIR are discussed.

State Implementation Plans

Congress placed responsibility for controlling air pollution with state and local government and required states to develop plans to maintain air quality standards. These plans are referred to as State Implementation Plans (SIPs). Kentucky's SIP is developed and administered by the Kentucky Divison for Air Quality.

With the adoption of the Clean Air Act and its amendments, Congress placed responsibility for control of air pollution at its sources with state and local governments. The federal role is to provide states with financial assistance and leadership (42 USC 7401(a)(3) and (4)). The Clean Air Act requires each state to develop a plan describing how it will attain and maintain various air quality standards, in effect, how the state plans to clean up polluted areas and keep them clean (42 USC 7407(a)). These plans are called State Implementation Plans, or SIPs. In general, a SIP is a collection of documents explaining how the state will monitor emissions, model emissions, develop emissions inventories, and control air pollution, all in order to attain and maintain the standards set by the federal government (42 USC 7410(a)). The Kentucky Environmental and Public Protection Cabinet's Division for Air Quality is responsible for developing and administering Kentucky's SIP.

Whenever EPA revises any of the standards, each state must conduct a public hearing on how the state will enforce the standards. Within three years of EPA's revision, each state must submit a plan that provides for implementation, maintenance, and enforcement of the new standards in each air quality control region (or portions of them) in the state (42 USC 7410(a)(1)). A state or local government may adopt emissions requirements or standards that are stricter than the federal standards, but it may not adopt a standard that is less stringent than the federal standard (42 USC 7416).

National Ambient Air Quality Standards

EPA is responsible for establishing National Ambient Air Quality Standards to protect public health and welfare.

Under the Clean Air Act, Congress regulates national air quality by requiring EPA to establish National Ambient Air Quality Standards for air pollutants that endanger public health or welfare (42 USC 7409(a)(1)(A)). Public health refers to the health of "sensitive" populations such as asthmatics, children, and the elderly. Public welfare refers to degree of visibility within an area

and the well-being of animals, crops, vegetation, and buildings within an area.

EPA established several primary and secondary standards for specific pollutants.

EPA established primary standards for certain types of air pollutants, which are set to protect public health. For some air pollutants, EPA established secondary standards to protect public welfare. The pollutants for which standards were set include SO_2, NO_x, ground-level ozone, and PM-2.5. Every five years, EPA must review these standards and publish revisions as appropriate (42 USC 7409(d)(1)).

Table 1.1 shows the pollution standards that were developed by EPA (U.S. Environmental. "National"). Standards are compared against pollution measures that are taken over a period of time. For example, for the 8-hour ozone standard, hourly measures are taken and averages are calculated for 8-hour periods. The fourth-highest of these 8-hour averages during each of three years are averaged and then compared to the standard (U.S. Environmental. "Guidelines").

Table 1.1
National Ambient Air Quality Standards

Pollutant	Averaging Times	Primary Standard	Secondary Standard
Carbon Monoxide	8-hour	9 ppm (10 mg/m)	none
	1-hour	35 ppm (40 mg/m)	none
Lead	Quarterly Average	1.5 µg/m	1.5 µg/m
Nitrogen Dioxide	Annual	0.053 ppm (100 µg/m)	0.053 ppm
Particulate Matter (PM-2.5)	Annual	15 µg/m	15 µg/m
	24-hour	35 µg/m	
Particulate Matter (PM-10)	24-hour	150 µg/m	
Ozone	8-hour	0.08 ppm	0.08 ppm
	1-hour	0.12 ppm	0.12 ppm
Sulfur Oxides	Annual	0.03 ppm	-----
	24-hour	0.14 ppm	-----
	3-hour	-----	0.5 ppm (1300 µg/m)

ppm – parts per million by volume
µg/m – micrograms per cubic meter of air
mg/m – milligrams per cubic meter of air
Source: U.S. Environmental. "National Ambient Air Quality Standards (NAAQS)."

Areas that do not meet a particular standard are classified as nonattainment for that pollutant.

Kentucky's Nonattainment Areas. Each state is required to monitor its air quality. The results of the monitoring data are compared to the air quality standards. Areas within the state are then assigned to one of the following designations for each standard:

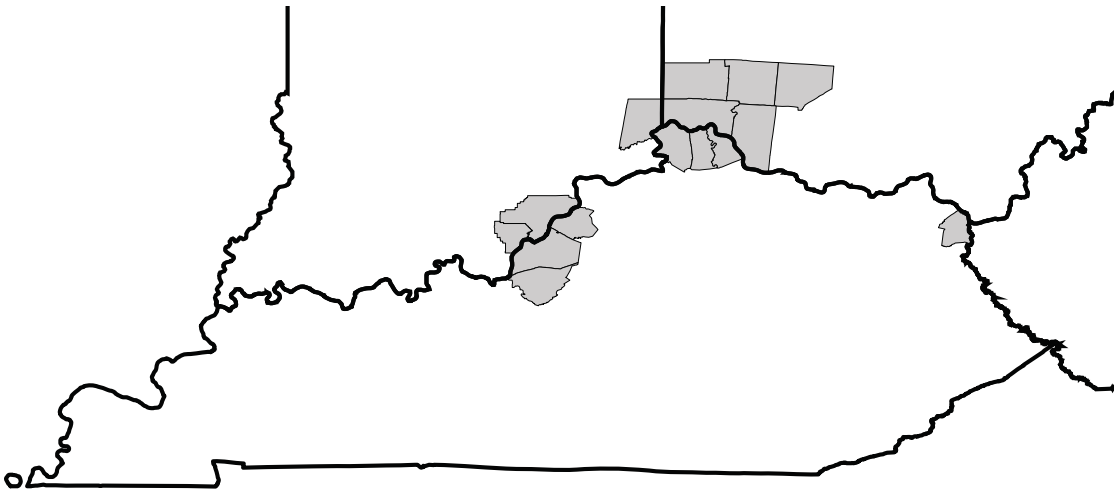
- nonattainment (does not meet the standards),
- attainment (meets the standards), or
- unclassifiable (cannot be classified on the basis of available information as meeting or not meeting the standards).

The governor of each state must submit to EPA a list showing the designations of all areas within the state (42 USC 7407(d)(1)(A)). EPA may then modify the designations as it deems necessary (42 USC 7407(d)(1)(B)(i)).

Kentucky has seven counties that are classified as nonattainment for the 8-hour ozone standard and seven counties that are classified as nonattainment for the PM-2.5 standard.

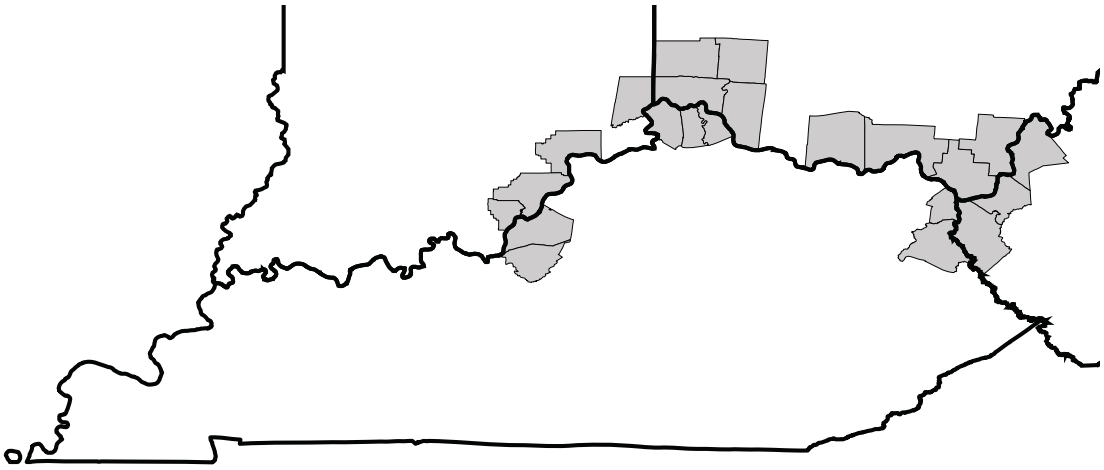
Kentucky has seven counties that are in nonattainment for the 8-hour ozone standard and seven counties that are in nonattainment for the PM-2.5 standard. Figures 1.A and 1.B show these nonattainment areas respectively. While the two maps are similar, Oldham County is classified as nonattainment only for ozone, and Lawrence County is classified as nonattainment only for PM-2.5. It should be noted that some nonattainment areas cross state borders. For example, in Figure 1.A, Bullitt, Jefferson, and Oldham Counties are part of the Louisville—Kentucky, Indiana nonattainment area. The other Kentucky counties that are in nonattainment are also part of a multistate nonattainment area.

Figure 1.A
Nonattainment Areas for the 8-hour Ozone Standard



Source: U.S. Environmental. "Currently Designated Nonattainment Areas for All Criteria Pollutants."

Figure 1.B
Nonattainment Areas for the PM-2.5 Standard



Source: U.S. Environmental. "Currently Designated Nonattainment Areas for All Criteria Pollutants."

States must submit a SIP that incorporates a plan for each nonattainment area that shows how pollution will be reduced within the areas.

A state must submit a State Implementation Plan to EPA that incorporates a plan for each area that has been designated nonattainment for one of the standards (42 USC 7502(b)). The plan must include control measures and means or techniques to achieve attainment. Control measures include economic incentives such as fees, marketable permits, and auctions of emissions rights (42 USC 7502(c)(6)). Thus, a trading program may be set up by the state or region to bring an area into attainment.

EPA requires that states develop stringent controls for stationary sources within nonattainment areas. A stationary source is a source of pollution that has a fixed location.

EPA mandates that for areas designated as nonattainment, the state adopt stringent technology controls for all stationary sources of pollution. Stationary sources refer to sources of pollution that are at fixed locations. This would include sources such as electric generating units or cement kilns. EPA also requires permits for any construction or operation of a new or modified stationary source and requires that the additional pollution be offset by a comparable amount of pollution reduction from another stationary source in the area (42 USC 7502(c)). Furthermore, nonattainment areas must show "reasonable further progress" toward attainment (42 USC 7502 (c)(2)).

When developing a SIP, a state has some flexibility as to how pollution will be reduced.

State Implementation Plan Requirements. States have some flexibility in how they achieve and maintain the air standards; however, SIPs are held to certain requirements. The following are some questions that EPA considers when approving a plan. Does it

- include enforceable emissions limitations and other control measures or techniques? (42 USC 7410(a)(2)(A))

- provide a means to monitor, compile, and analyze air quality data? (42 USC 7410(a)(2)(B))
- include a permit program for emissions sources? (42 USC 7410(a)(2)(C))
- prevent significant deterioration of the air quality in its attainment regions? (42 USC 7441)
- prevent its emissions from 1) contributing significantly to nonattainment in another state or 2) interfering with measures in another state to prevent deterioration of air quality? (42 USC 7410(a)(2)(D))
- ensure that the state will have adequate personnel, funding, and authority to carry out the SIP? (42 USC 7410(a)(2)(E))
- require the installation, maintenance, and replacement of monitoring equipment? (42 USC 7410(a)(2)(F)(i))

Sulfur Dioxide Cap and Trade Programs

EPA developed the Acid Rain Program as a cap and trade system to reduce emissions of SO_2 in the 48 contiguous states.

EPA designed the Acid Rain Program to limit the emissions of SO_2 using a cap and trade system. EPA sets limits on the total amount of SO_2 that may be emitted from stationary sources within the 48 contiguous states and requires that each stationary source hold a sufficient number of allowances to cover its emissions. EPA began enforcing these restrictions in 1995. In 2005, EPA issued the Clean Air Interstate Rule. CAIR provides additional restrictions for 25 states, including Kentucky, and the District of Columbia above those required by the Acid Rain Program. EPA will begin enforcing CAIR restrictions in 2010. The restrictions mandated under CAIR will be achieved by requiring sources located within these 25 states and the District of Columbia to hold a greater number of SO_2 allowances for each ton of SO_2 emitted.

The Acid Rain Program was implemented in two phases. The first phase ran from 1995 through 1999 and targeted large electric generating units. The second phase started in 2000 and targeted electric generating units that could produce at least 25 megawatts of electricity.

Acid Rain Program—SO_2 Trading Program. To address concerns about acid rain, the Clean Air Act Amendments of 1990 imposed limitations on the amount of SO_2 that electric generating units could emit. These restrictions were established in two phases. Phase I occurred from 1995 through 1999 and targeted large electric generating units (42 USC 7651c). Beginning in 2000, Phase II required further restrictions on emissions and extended the limitations to all electric generating units that could produce at least 25 megawatts of electricity (42 USC 7651d). A 1997 report from the U.S. Department of Energy's Energy Information Administration indicated that Phase II was expected to cover nearly all electric power producers ("The Effects").

Through the Acid Rain Program, EPA established a cap for SO_2 emissions, created allowances to emit SO_2, and developed a

trading program for these allowances. For Phase I, EPA capped the amount of SO_2 to reduce emissions by 10 million tons from the level in 1980 (42 USC 7651(b)). In Phase II, EPA capped the amount of SO_2 that electric generating units could produce in aggregate each year at approximately 8.9 million tons (42 USC 7651b(a)(1)).

Each year, EPA allocates the SO_2 allowances to the sources of emissions. There is no charge for the majority of these allowances. Three percent, however, are sold through an auction.

Each year, EPA distributes a number of allowances equal to the cap for the year. An allowance permits each source to release one ton of SO_2.[1] Allowances are distributed in one of two ways. Most allowances are allocated to the owners of electric generating units. These allowances are allocated directly to sources of SO_2 emissions rather than to state or local governments (42 USC 7651b(a)(1)). Most of the allowances are initially allocated by EPA at no cost to the recipient sources (42 USC 7651b(a)(1)).[2] A small portion of allowances, 3 percent, are sold by EPA through an auction (42 USC 7651o).

As noted, the trading program began in 1995. Electric generating units that began operating in 1996 or later are not allocated allowances. Owners of these units must purchase allowances from the market or from EPA auction to cover their SO_2 emissions (U.S. Environmental. "Acid Rain Program SO_2 Allowances").

Each source must turn in a sufficient number of allowances to cover its emissions for the year.

Each year, each source documents the amount of emissions that it produced. Each source is required to surrender an allowance for each ton of SO_2 it emitted during the year. For example, if the monitoring data indicated that a source emitted 50 tons during the past year, the owner of the source must surrender 50 allowances.

Allowances may be bought or sold by any individual, corporation, environmental group, or governing body.

As with most cap and trade programs, holders of allowances are not required to use their allowances. Allowances may be bought and sold. For example, if a source of SO_2 pollution emits 50 tons of SO_2 and its owner holds 70 allowances, the remaining 20

[1] An allowance is a limited authorization to emit. According to the United States Code, an allowance does not constitute a property right and nothing limits the authority of the United States to terminate or limit the authorization (42 USC 7651b(f).

[2] SO_2 allowances are allocated to the affected units based on each unit's historic heat input. During Phase I, EPA established a baseline heat input for each unit based on its average heat input from 1985 through 1987. Units were then allocated a number of allowances that would permit them to emit 2.5 pounds of SO_2 per mmBtu of heat. The measure mmBtu refers to the amount of energy produced. Therefore, if a unit's baseline heat input was 800 mmBtu, it would be allocated one allowance (800 mmBtu x 2.5 lbs = 1 ton or one allowance). During Phase II, units were allocated a number of allowances that would permit them to emit 1.2 pounds per mmBtu of heat input (U.S. Environmental. "Acid Rain Program SO_2 Allowances").

allowances may be sold to an entity that does not have sufficient allowances to cover its emissions. Allowances may be bought, sold, traded, donated, or retired by any individual, corporation, or governing body, including brokers, municipalities, environmental groups, and private citizens (U.S. Environmental. "Acid Rain Program SO_2 Allowances"). In some instances, environmental groups have purchased and retired allowances. Doing this restricts the number of allowances available to cover emissions, thus reducing the total level of SO_2 that may be emitted.

Allowances may also be banked for future use.

Allowances may also be banked for later use. For example, an electric utility might produce relatively little SO_2 during a mild summer and therefore have excess allowances. The utility can hold these allowances and use them during a warmer year when more SO_2 is emitted.

If a source does not have a sufficient number of allowances to cover its emissions, EPA will impose a penalty of approximately $3,000 and reduce the number of allowances the source will receive in the following year.

A source that does not have a sufficient number of allowances to cover its actual emissions of SO_2 for a calendar year must pay an excess emissions penalty (42 USC 7651j(a)). In 1990, the fine was set at $2,000 per ton for which there was no allowance. The fine is adjusted annually for inflation and for 2006 was about $3,000 per ton (U.S. Environmental. "Acid Rain Program Annual Reconciliation"). As a further penalty, the source must offset its excess emissions by an equal tonnage amount in the following calendar year (42 USC 7651j(b)).

In 2005, EPA issued the Clean Air Interstate Rule (CAIR), which will further restrict emissions of SO_2 for 25 eastern states, including Kentucky.

Clean Air Interstate Rule—SO_2. The Clean Air Interstate Rule will further restrict emissions of SO_2 by requiring additional SO_2 reductions in 25 eastern states, including Kentucky, and the District of Columbia. In addition to contributing to acid rain, SO_2 is a building block of PM-2.5 and can be easily carried by the wind from one state to another. The CAIR program was designed to reduce the amount of SO_2 that is transported across states. As with the Acid Rain Program, the CAIR SO_2 program will be implemented in two phases. The first phase will cover 2010 through 2014. The second phase will begin in 2015.

Kentucky's sources of SO_2 will be allocated 188,773 allowances per year from 2010 through 2014 and 132,141 per year after 2014.

The SO_2 national caps will be 3.674 million tons from 2010 through 2014 and 2.572 million tons by 2015 (Lankton). Under CAIR, sources in Kentucky will be allocated 188,773 SO_2 allowances per year from 2010 through 2014. After 2014, sources located in Kentucky will be allocated 132,141 SO_2 allowances (Commonwealth. Environmental. KY Division. "Kentucky's CAIR SIP").

The Acid Rain Program will continue, but the reductions under CAIR will be achieved by requiring sources covered by CAIR to surrender a greater number of allowances for each ton of SO_2 emitted.

It is important to note that the national Acid Rain Program will still be in effect. The SO_2 reductions required under CAIR will be made by sources in the 25 states covered by CAIR. These reductions are in addition to the reductions these sources are already required to make under the Acid Rain Program. The reductions will be achieved by requiring sources in a state covered by CAIR to provide a greater number of allowances to cover its emissions.

For sources subject to CAIR, each allowance received before 2010 would continue to cover one ton of emissions. The allowances received between 2010 and 2014, however, will only cover one-half of a ton. The allowances received after 2014 will only cover 35 percent of one ton. Reducing the amount of emissions each allowance covers reduces the total amount of emissions that may be produced.

A state may participate in the EPA-administered cap and trade program or develop its own strategies for reducing SO_2 emissions in the state.

CAIR gives states the flexibility to reduce SO_2 emissions using a strategy that best suits their circumstances. A state may adopt the EPA-administered regional cap and trade program as one option (40 CFR 96 Subpart AAA). Because EPA has already approved this program in full, a state that adopts EPA's program would be relieved of the time and expense required to revise its SIP. Kentucky has chosen this option (401 KAR 51:230). A state may also adopt some other form of control mechanism of its own choosing (40 CFR 96.201).

States that participate in EPA's trading program do not have the option of using a different method for allocating allowances.

If a state uses EPA's cap and trade program, the emissions budget is set in the same way as it is under the Acid Rain Program. States that participate in the trading program do not appear to have the option of developing a different allocation method from that used by EPA.

If a state wishes to allow units that are not ordinarily covered in the EPA-administered SO_2 trading program to opt in voluntarily, the state must submit an abbreviated SIP. An abbreviated SIP allows the state to use the EPA-administered program except for this change (40 CFR 96 Subpart III).

The penalty for not holding a sufficient number of allowances is greater under CAIR than just the Acid Rain Program. Sources subject to CAIR that do not maintain a sufficient number of allowances will be allocated fewer allowances in later years.

The penalty for not holding a sufficient number of allowances to cover emissions is different under CAIR. EPA will first determine the penalties under the Acid Rain Program. If a source has emissions exceeding its Acid Rain Program allowances, that shortage will be deducted from the following year's allocation under the Acid Rain Program.

EPA will also impose additional penalties under CAIR. If a source has emissions exceeding its CAIR SO_2 allowances, the allowance shortage will be deducted from the following year's allocation at a 3:1 tonnage rate, using the CAIR values of 1 allowance per 1 ton for pre-2010 allowances, 0.50 allowances per ton for 2010-2014 allowances, and 0.35 allowances per ton for 2015 and beyond allowances. For example, if a source has 3 tons of excess emissions in 2012, those 3 tons will be multiplied by 3, meaning that the source must cover an extra 9 tons of emissions in 2013. The 9 tons will be covered by allowances valued at the CAIR rates. If the allowances are issued in 2013, they are worth 0.50 tons each, meaning the source would have to use 18 allowances to cover the 9 extra tons (Shellabarger).

Nitrogen Oxide Cap and Trade Program

As part of the Clean Air Act Amendments of 1990, Congress required reductions of NO_x emissions. It did this by setting emissions limits for specific sources rather than by developing a cap and trade program (U.S. Environmental. "NO_x Budget"). These limits began in 1996 for some of the largest sources of NO_x that were also subject to the SO_2 requirements and in 2000 for some additional coal-fired generating units (42 USC 7651f)).

Regulations issued in 1998 established the cap and trade program for NO_x. Enforcement of the cap began in 2004. EPA created the NO_x Budget Trading Program to reduce NO_x emissions through a cap and trade program. The program limits the amount of NO_x that may be emitted by certain units from May 1 through September 30 of each year. The program covers primarily electric generating units and large industrial units that produce electricity.

NO_x Budget Trading Program. The cap and trade program for NO_x resulted from regulations issued in 1998. These regulations, called the NO_x SIP Call, were designed to reduce the regional transport of ozone and ozone-forming pollutants in the eastern half of the United States. The reductions were accomplished by setting caps on the total amount of emissions certain sources could produce. The sources affected included electric generating units and large industrial units that produce electricity (63 FR 57355). Some states have included other types of units, such as petroleum refinery process heaters and cement kilns. The rule required states to reduce NO_x emissions from May 1 through September 30 of each year. This period of the year is referred to as the ozone season because it is when ozone peaks. States and owners of the sources of NO_x emissions were given several years to prepare for the caps. EPA began enforcing the reductions in 2004.

States had the option of developing their own strategies for reducing the NO_x emissions or adopting EPA's model cap and trade system. All of the states that were subject to the NO_x SIP Call adopted the model system.

While the NO_x SIP Call required a reduction in the total amount of NO_x emitted, it did not mandate which sources must reduce emissions. Rather, it required states to meet emissions budgets and gave them flexibility to develop control strategies to meet those budgets (63 FR 57457-58). EPA developed a model cap and trade program, which states could adopt (40 CFR 96 Subpart A). Under

the NO_x Budget Trading Program, EPA sets a regional cap and allocates allowances to the affected states. These allowances can be traded in a similar manner as the SO_2 allowances. All affected states and the District of Columbia chose to meet the mandatory NO_x SIP Call reductions by participating in the program. EPA administers the trading program, but states share responsibility with EPA by allocating allowances, inspecting and auditing sources, and enforcing the program.

An emissions budget refers to the amount of allowances that are allocated to a state. If sources within the state purchase additional allowances, emissions within the state may exceed the number of allowances that were initially allocated.

The NO_x emissions cap is expressed as an "emissions budget" for electric generating units located within each affected state. EPA determined each state's budget by estimating the amount of NO_x sources in the state would emit if certain controls were adopted. The emissions budgets are not necessarily a limit on emissions from affected sources within a state. The emissions budgets are a total of allowances that will be distributed to electric generating units in a given state. Because the trading program is a regionwide cap and trade program, affected sources in a given state might purchase allowances from sources in other states in the region, and then emit NO_x in amounts that are higher or lower than their state's emissions budget (63 FR 57460).

Table 1.2 shows Kentucky's NO_x budget for 2004 through 2008. In total, Kentucky was allocated 36,504 allowances for electric generating units and 179 allowances for nonelectric generating units from 2004 through 2006. Each allowance represents one ton of NO_x emissions. For the initial 2004-2006 allocation period, Kentucky allocated 95 percent of these allowances to existing sources based on each source's historical heat input. Five percent of these allowances were set aside for new sources and sold through a broker. For each allocation period beginning with 2007, Kentucky allocates 98 percent of its allowances to existing sources and sells the remaining 2 percent (Commonwealth. Environmental. KY Division. "Kentucky's NO_x SIP Call Plan" Sect. 3.1, 2002).

Table 1.2
Kentucky's NO_x Allowances

Source	2004-2006	2007-2008
Electric Generating Units	36,504	36,504
Nonelectric Generating Units	179	64

Each allowance represents one ton of emissions.
Source: Commonwealth. Environmental and Public Protection Cabinet. KY Division of Air Quality. "Kentucky's NO_x SIP Call Plan" Jan. 2002 and March 2006.

After the ozone season, each source must surrender a sufficient number of allowances to cover its emissions. Any remaining allowances may be sold to another source or held for later use.

At the end of each ozone season, each source must surrender enough allowances to cover its actual NO_x emissions during the season. This process is called the annual reconciliation. If a source does not have enough allowances to cover its emissions, EPA will automatically deduct three allowances from the following year's allocation for each allowance the unit is short (40 CFR 96.54(d)).

If a source has excess allowances because it reduced emissions beyond required levels, it can sell the unused allowances or bank them for use in a future ozone season. The program also has provisions to discourage extensive use of banked allowances in a particular ozone season. If the amount of banked allowances exceeds 10 percent of the budget for a year, a portion of the banked allowances will cover less than one ton of emissions.

To accurately monitor and report emissions, sources use continuous emissions monitoring systems or other monitoring methods approved by EPA (40 CFR 75). Sources are required to conduct quality assurance tests of their monitoring systems.

CAIR will require further restrictions on the amount of NO_x emitted in 28 states, including Kentucky. Under CAIR, there will be an ozone season and an annual NO_x program.

Clean Air Interstate Rule. In addition to providing greater restrictions on SO_2, CAIR will also increase the restrictions on NO_x emissions in 28 eastern states, including Kentucky (U.S. Environmental. Clean Air Interstate Rule: Basic). CAIR requires further restrictions on the amount of NO_x emitted in order to assist states in attaining the ozone and PM-2.5 National Ambient Air Quality Standards. CAIR creates ozone season and annual NO_x programs. Initial reductions under the annual and ozone season programs will be required in 2009, and further reductions will be required in 2015 (70 FR 25161).

Table 1.3 shows the NO_x budgets for Kentucky under CAIR. From 2009 through 2014, Kentucky's annual budget will be 83,205 allowances. After 2014, the annual budget decreases to 69,337. The budget for the ozone season will be 36,109 from 2009 through 2014 and 30,651 thereafter. According to its SIP for implementing CAIR, Kentucky will sell 2 percent.

Table 1.3
Clean Air Interstate Rule NO_x Budget for Kentucky

Years	Annual Budget	Ozone Season Budget
2009-2014	83,205	36,109
After 2014	69,337	30,651

Each allowance represents one ton of emissions.
Source: U.S. Environmental. "Sulfur Dioxide Allowance."

An important change that will occur with CAIR is the amount of emissions that a banked allowance will cover. Currently, if banked allowances exceed a threshold, a portion of the banked allowance will cover less than one ton of NO_x emissions. Under CAIR, the amount of emissions covered by a banked allowance will not be reduced. Sources will be able to use banked allowances for the NO_x ozone season program on a 1:1 basis (40 CFR 96.355). Current provisions to discourage use of banked allowances in a particular ozone season will be eliminated as of 2009 with the start of the CAIR program.

As with the other programs, states have some flexibility in how they meet the restrictions.

As with some of the other federal requirements to reduce emissions, states have some flexibility in how they achieve the reductions required under CAIR. First, states may adopt a federal model rule, which includes the NO_x cap and trade program. EPA will administer all aspects of the NO_x cap and trade programs for states that adopt the rule (codified at 40 CFR 96). Adopting the federal plan saves states the time and expense of revising their State Implementation Plans but does not provide options for the states to deviate from the plan.

States may adopt the federal model that includes a trading program. Under this option, EPA determines how allowances are allocated and the sources that are covered by CAIR.

The model rule includes various provisions that dictate how allowances will be allocated, how allowances placed in a compliance supplement pool may be used, and whether nonelectric generating units may participate. Under the rule, a portion of the allowances from 2009 would be set aside for new sources. From 2009 to 2014, 5 percent would be set aside. After 2014, 3 percent would be set aside (40 CFR 96.142(c)(1)). The remaining allowances would be allocated to existing sources based on their past heat input adjusted for the type of fuel burned (U.S. Environmental. “CAIR Statewide NO_x Budgets” 3).

A portion of the 2009 annual emissions budget will be placed into the annual NO_x compliance supplemental pool (40 CFR 96.143). Under the model rule, these allowances are used to encourage early reductions of NO_x. An owner of a source may be able to receive allowances from this pool if emissions from the source can be reduced below its allocation of allowances.

While in the past, nonelectric generating units were able to participate in the older NO_x Budget Trading Program, under the rule ozone season trading program, they will not be able to participate (U.S. Environmental. “Clean Air Markets”).

States may also adopt the federal model with a few modifications. These modifications give the states somewhat greater latitude in determining how allowances are allocated and which sources will be covered by CAIR.

States may also submit an "abbreviated SIP" that allows them to participate in the cap and trade program and that provides them with a few additional options. Kentucky has done this (Commonwealth. Environmental. KY Division. "Kentucky's CAIR SIP"). The abbreviated SIP may modify the following four elements of the model rule by

- allowing units that are not otherwise CAIR units to individually opt into the FIP trading programs,
- allowing the state, rather than EPA, to allocate NO_x annual or ozone season allowances,
- allowing the state, rather than EPA, to allocate allowances from the NO_x annual Compliance Supplement Pool, and
- including NO_x SIP Call trading sources that are not electric generating units under CAIR in the CAIR FIP NO_x ozone season trading program (U.S. Environmental. "Clean Air Markets").

States opting for the abbreviated SIP would still be covered by the FIP for all other aspects of the cap and trade programs.

Finally, states may develop their own plans for reducing NO_x emissions, but the plans are subject to EPA approval.

Finally, if policy makers within a state prefer greater control of how they achieve the required NO_x reduction, the state may develop its own strategies for reducing emissions. States choosing this option must submit a SIP detailing how the reductions will be made. A state has considerable flexibility in developing its strategies but is subject to EPA approval (70 FR 25258).

Offset Requirements

Federal regulations require that an increase in certain emissions from a major new or expanded stationary source within a nonattainment area be offset by a reduction in emissions from other stationary sources within the area.

In addition to establishing specific cap and trade programs to reduce the emissions of SO_2 and NO_x, federal requirements include a number of provisions to address pollution in areas that are classified as nonattainment. One of these provisions requires that any increase in emissions from a major new or modified stationary source be offset by a corresponding reduction in emissions by existing sources (42 USC 7503(c)(1)).

For example, assume the owners of a manufacturing firm with a production process that emits pollution are considering a location within a nonattainment area for ozone. Because there is a limit on the amount of pollution that may be emitted, the plant can only locate within the nonattainment area if there is a corresponding decrease in emissions from other stationary sources within the nonattainment area. The necessary emissions reductions must be in effect and enforceable at the time the new source begins emitting.

With the exception of Jefferson County, offsets are generally not traded in Kentucky nonattainment areas.

The Division of Air Quality administers the offset requirements for Kentucky's counties that are in nonattainment, with the exception of Jefferson County. With the exception of Jefferson County, offsets are generally not traded. Instead, a business considering a location within a nonattainment county other than Jefferson County may apply for offsets from the Division of Air Quality. If emissions from existing sources in the area had been reduced and offsets are available, the division may approve the application. In some instances, reductions that occur within Jefferson County could be used to offset increases in the other counties that are in the Louisville—Kentucky, Indiana nonattainment area (42 USC 7503(c)(1)).

Within Jefferson County, offsets for volatile organic compounds are administered through a system of emission reduction credits. These credits can be bought and sold.

Emissions Trading Program in Jefferson County. Offsets within Jefferson County are administered differently from other nonattainment areas in Kentucky**.** The Louisville Air Pollution Control District is responsible for monitoring and regulating air quality standards within Jefferson County. As part of its responsibilities, the district has developed a system of trading offsets that are created within the county. These offsets are referred to as emission reduction credits.

Because Jefferson County is classified as nonattainment area for ozone, there are limits on the amount of volatile organic compounds (a building block of ozone) that may be emitted by stationary sources within the county. Offsets are required before another stationary source may increase its emissions. When owners of stationary sources within Jefferson County reduce their emissions below the required limit, they may apply for emission reduction credits. For example, if a source is restricted to producing no more than 10 tons of volatile organic compounds but is able to reduce its emissions to 8 tons, the owner of the source could qualify for 2 tons of credits. These credits may then be used to offset an increase in the compounds from another source.

While credits may be traded, the market for the credits is less formal than the market for federal trading programs.

Louisville's local regulations allow owners of the credits to transfer them to others or hold them for future use. The market for emission reduction credits in Jefferson County is less formal than the market for the federal trading programs for SO_2 and NO_x. Those holding the credits may transfer them to another entity. Negotiations for the transfer may occur between the two parties making the trade. The district's role in the trade is to provide technical information and to record the transfer.

If a business that holds credits permanently shuts down its operations, its credits would revert to a community bank. These

credits could then be used to cover additional emissions created by an expansion of a stationary source or a new stationary source (Louisville APCD Reg. 2.12, Sec. 4.6).

Summary

Cap and trade programs can be initiated at the local level, at the state level, or at the federal level. The pollutants being traded by a given trading program, and the ease with which a pollutant is transported to other states, play a large role in determining a program's legal framework. States are not required to participate in the federal cap and trade programs for SO_2 and NO_x. These programs provide a ready-made set of rules which, if adopted, ensures EPA approval of a state's implementation plan. The federal programs usually allow for some state modification of the rules; although, the more a state deviates from the federal rules, the more concerned it must be about EPA approval of its SIP. States that choose to participate in the SO_2 cap and trade program have little flexibility in how allowances are allocated. States that participate in the NO_x cap and trade program, however, have some flexibility in how allowances are allocated. Programs initiated in nonattainment areas must abide by a number of federal regulations. However, in general, the governing agency still has flexibility as long as it can demonstrate to EPA that its plan will result in achieving attainment.

Chapter 2

Description of Emissions Trading Market and Economic Effects

Introduction

The method used to allocate allowances determines who receives the benefits associated with the allowances. Whether trading occurs determines the degree to which firms can find lower cost methods of reducing emissions.

The legal framework for the major emissions trading programs provides the rules for how allowances may be allocated to sources of emissions and how allowances may be traded. Given that there are restrictions on the level of emissions that may be produced, allowances are a benefit to the firms that must generate these emissions as part of their businesses. The allocation serves to distribute these benefits in some manner to the sources of pollution. Trading is then intended to allow the owners to find the most efficient means to reduce total emissions.

This chapter builds on the legal framework by describing how allocation methods determine which firms receive benefits and how trading affects firms' costs of complying with environmental regulations. The chapter begins with a description of the trends within the market for SO_2 and NO_x allowances and then discusses how allocating and trading allowances affect the economy. The report concludes with a discussion on the economic issues associated with the emission reduction credits for volatile organic compounds in Louisville.

Emissions Allowance Market Trends

Market data show past prices of SO_2 and NO_x allowances.

Allowances for SO_2 and NO_x are bought and sold either through auctions developed by federal and state governments or through brokers. The following sections discuss price trends in the SO_2 and NO_x allowance markets and show how allowances have been allocated, used, and traded in Kentucky. The data on prices comes from Cantor-Fitzgerald, a brokerage firm that specializes in trades of environmental allowances. The price data do not include prices for all trades of SO_2 and NO_x allowances, but, according to Cantor-Fitzgerald representatives, reflect the majority of trades. The data on how allowances are allocated, used, and traded come from the EPA reconciliation process. As noted in Chapter 1, each source of emissions is required to surrender an allowance for each ton of pollution it emits. There are separate reconciliations for SO_2 and NO_x. EPA staff, however, indicated that some sources might not have gone through the reconciliation process at the time the data

were generated. As a result, the amounts shown may not equal the allocations shown in other reports.

SO_2 Allowances

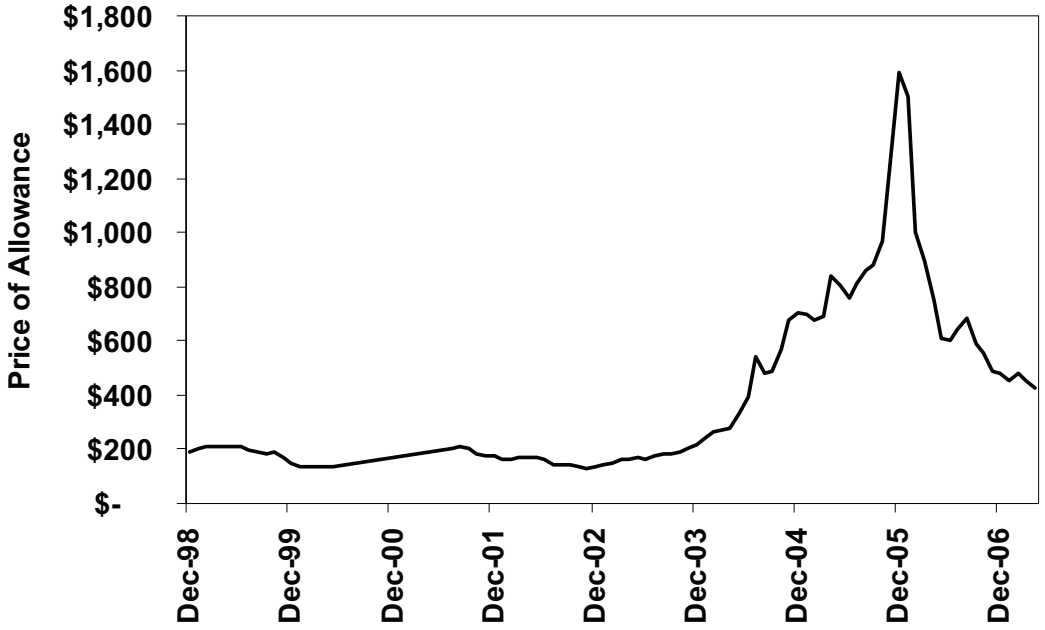
The price of SO_2 allowances was fairly stable until spiking in 2005.

Figure 2.A show average monthly prices for SO_2 allowances.[1] Prices of SO_2 allowances were relatively stable from 1998 through 2002. During 2003, prices began to rise and eventually peaked in December 2005. Since 2005, prices have declined.

The price spike may be due to a number of factors including utilities purchasing extra allowances in expectation of more stringent regulations and utilities burning more coal as natural gas prices increased.

There have been several explanations offered for this spike. In a report to EPA, Resources for the Future indicated that the spike might be attributable to increasing natural gas prices (Lankton). As natural gas became more expensive, it would be more cost efficient for electric utilities to generate electricity using coal, which produces more SO_2. Greater use of coal would then increase demand for SO_2 allowances, which results in higher prices. EPA, however, indicated that the spike occurred as electric utilities increased their purchases of SO_2 allowances in anticipation of greater restrictions under CAIR (U.S. Environmental. "Acid Rain Program, 2005").

Figure 2.A
SO_2 Allowance Prices



Source: Staff analysis of data provided by Cantor-Fitzgerald.

[1] Because prices are shown as monthly averages, much of the variability in prices is not shown on this graph. The average prices, however, provide a sense of the trend within this market.

Data from the EPA reconciliation process shows the number of SO_2 allowances allocated, traded, held, and used each year. The data on the number of SO_2 allowances traded only show the difference between the number of SO_2 allowances sold by Kentucky sources to sources outside Kentucky and allowances purchased by Kentucky sources from sources outside Kentucky.

Table 2.1 summarizes the flow of SO_2 allowances in Kentucky. EPA data do not provide the number of allowances traded but do include the number of allowances allocated, held, used, and carried forward each year. Using the data that were reported, it was possible to determine the net level of trading that occurred for Kentucky. For example, it would not be possible to determine that Kentucky sources as a group sold 10,000 SO_2 allowances to sources in other states while purchasing 15,000 from sources in other states. What can be seen, however, is the net purchasing and selling. Therefore, in the example above, one would observe that Kentucky sources had net purchases of 5,000 allowances. This shows whether Kentucky sources were net importers or net exporters of allowances.

In 2001, Kentucky sources had nearly 387,000 allowances from the previous year and were allocated approximately 382,000. Net purchases for the year totaled almost 70,000. In total, Kentucky sources held approximately 838,000 allowances. SO_2 emissions for these sources were 535,000 tons and one allowance would have to be surrendered for each ton emitted. This would leave 303,000 allowances to be carried forward for later use.

Kentucky sources typically emit more SO_2 than their allocation of allowances would cover. This has resulted in Kentucky sources purchasing SO_2 allowances from sources in other states.

Overall, sources located in Kentucky emitted more SO_2 than their annual allocations would cover. As a result, these sources have purchased additional allowances to cover the greater level of emissions. Kentucky sources have also maintained an inventory of allowances as shown by the number carried forward each year.

Table 2.1
Allocation and Use of SO_2 Allowances in Kentucky

Allowances	2001	2002	2003	2004
Carried Forward From Last Year	386,678	302,824	278,507	234,304
Allocated	381,623	377,979	380,670	380,670
Net Traded	69,971	76,533	104,800	84,202
Held	838,272	757,336	763,977	699,176
Used	535,448	478,829	529,673	513,238
Carried Forward to Next Year	302,824	278,507	234,304	185,938

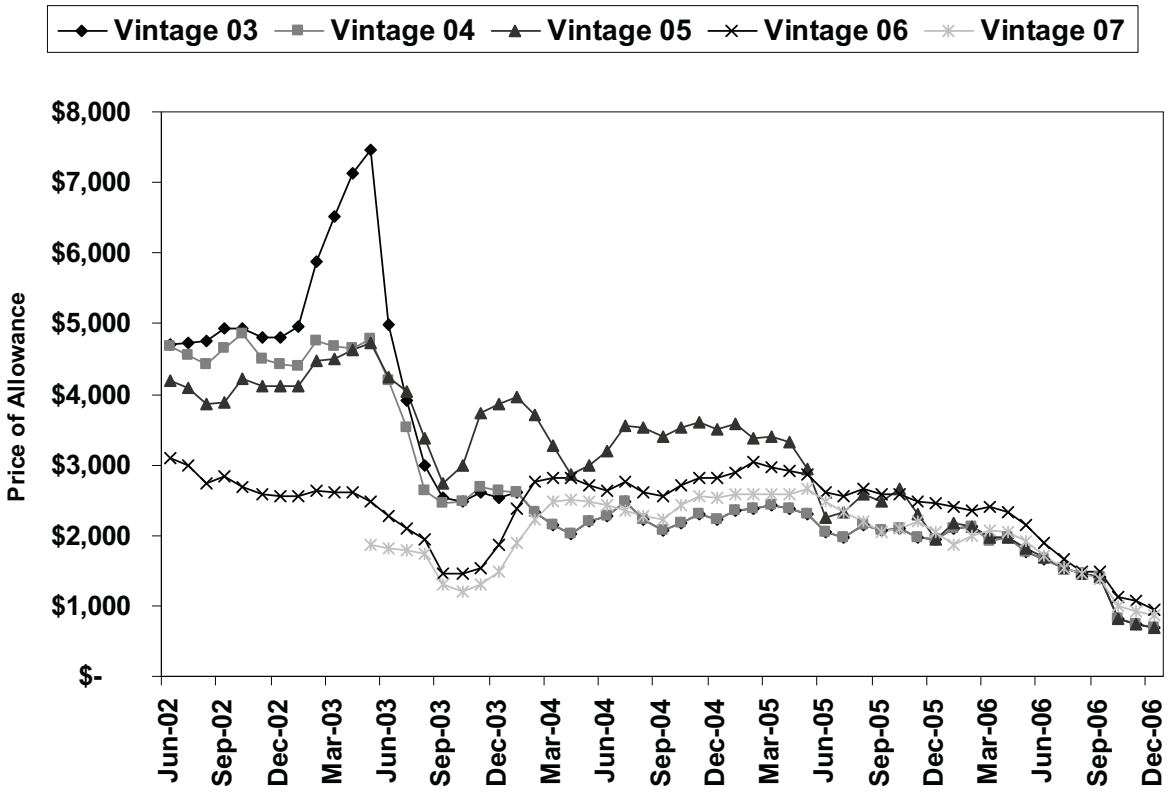
Source: Staff analysis of data provided by the U.S. Environmental Protection Agency.

NO_x Allowances

NO_x allowances are distinguished by the year in which they may first be used. Vintage 2005 NO_x allowances, for example, refer to allowances that may be first used in 2005. Average monthly prices for each vintage are show in Figure 2.B. While in the past, there were considerable differences between the prices for the various vintages, these prices have been converging. The price differences between vintages reflect differences in when and how different vintage allowances can be used.

Allowances are issued and can be traded before they can be used to cover emissions. For example, vintage 2007 allowances were allocated in 2003 and could be traded. These allowances cannot be used to cover emissions, however, until 2007. Therefore, allowances trade at relatively lower prices prior to their vintage year.

Figure 2.B
NO_x Allowance Prices



Source: Staff analysis of data provided by Cantor-Fitzgerald.

The provisions to discourage banking can reduce the number of banked allowances and therefore lower the market price of these older vintage allowances. As a result, different vintage allowances trade at different prices. When CAIR is effective in 2009, these provisions will no longer apply. There should be little practical difference between different vintage allowances, and their prices should be similar.

Prices for NO_x allowances have steadily decreased over time and are currently traded for approximately $700. The decrease may be attributable to cheaper ways of reducing emissions.

The general trend is lower prices. In March 2003, vintage 2003 NO_x allowances were being traded at prices above $7,000 per allowance. By the end of 2006, prices were around $700. As older electric generating units that produce greater levels of NO_x are retired, they may be replaced with newer units that are designed to emit less NO_x. This would reduce the demand for NO_x allowances and, therefore, the price of the allowances. Second, equipment that reduces emissions may be more efficient and less costly than in the past, which would also reduce the demand for allowances.

Table 2.2 summarizes the flow of NO_x allowances in Kentucky.[2] In 2004, stationary sources of NO_x emissions in Kentucky received more than 47,000 allowances.[3] At the end of the year, they held just fewer than 43,000, suggesting that on net more than 4,000 allowances were sold. By the end of 2004, these sources had emitted just more than 28,000 tons of NO_x, which left them with nearly 15,000 allowances that could be carried over for use at a later time. In 2005, Kentucky sources were allocated 34,133 additional allowances.

Kentucky sources are net importers of NO_x allowances in some years and net exporters of allowances in other years.

In two of the three years, Kentucky sources were net exporters of allowances. That is, more allowances were transferred out of the state than were transferred into the state. In 2005, however, Kentucky imported more allowances than it exported. Over all of these years, the number of allowances exported out of the state was the same as the number imported into the state.

[2] The data for this table also came from the EPA reconciliation process, which determines whether sources have a sufficient number of allowances to cover their emissions for the year. As with the SO_2 data, the NO_x data do not provide the number of allowances traded but do include the number of allowances allocated, held, used, and carried forward each year. The net amount of trading can then be determined from these figures. The references to years in the table refer to calendar years, not the vintage of the allowances.

[3] The allocation was high in 2004 relative to 2005 and 2006. There was a period during which sources could earn additional allowances by reducing emissions prior to 2004. These additional allowances for Kentucky are reflected in the table.

Table 2.2
Allocation and Use of NO_x Allowances in Kentucky

Allowances	2004	2005	2006
Carried Forward From Last Year	---	14,896	17,560
Allocated	47,406	34,133	34,133
Net Traded	(4,455)	5,265	(810)
Held	42,951	54,294	50,883
Used	28,055	36,734	37,472
Carried Forward to Next Year	14,896	17,560	13,411

Source: Staff analysis of data provided by the U.S. Environmental Protection Agency.

How Method of Allocation Affects Distribution of Benefits

Several methods for allocating emissions allowances have been discussed in the research literature, but the two methods most frequently discussed are distributing allowances at no charge and selling allowances on the market.

A firm holding an allowance benefits because the allowance provides an alternative to installing costly equipment to comply with the emissions requirements. The method of allocation can affect how these benefits are distributed. While several methods have been cited in the research literature, distributing allowances for free and selling allowances on the market are the two methods most frequently discussed.

If allowances are given to firms, those firms may have a cost advantage over their competitors that must purchase allowances. The firms receiving the allowances at no charge might be able to earn relatively higher profits.

Dinan and Rogers noted that if allowances are given to firms, the benefits of the allowances go to the firms. Firms that receive allowances at no cost will have a cost advantage relative to those that must purchase allowances. This advantage could allow firms receiving the allowances at no charge to earn a relatively higher profit than their competitors that must pay for allowances.

In some instances, these benefits might be passed on to the firms' customers in the form of lower prices.

Dinan and Rogers' comment that the benefits of the free allowances go to firms might be too general. There could be some mechanism to force the firms to pass the lower cost on to their customers through lower prices. This might come from competitive pressures or from government regulation.

Allocating Allowances to Electric Utilities at No Charge

Because the Kentucky Public Service Commission (PSC) regulates electric utilities, the benefit of the allowances is likely passed on to the utilities' customers.

In Kentucky, the majority of SO_2 and NO_x allowances are given to electric generating units. Many of these units are regulated by the Kentucky Public Service Commission (PSC). Because Kentucky's electric utilities are regulated, much of the value associated with the allowances may be passed on to the utilities' customers in the form of lower rates.

Owners of electric generating units in Kentucky sell electricity on two general markets. The first is the regulated market. Each

electric utility is granted exclusive rights to sell electricity within its service territory. Because the utility has exclusive rights to serve this geographic area, it generally faces little or no competition. However, the utility's service and rates are regulated by PSC. The second market, which is not regulated, largely consists of electricity sales between wholesalers of electricity. In this market, prices for electricity are determined by market forces rather than by the regulatory process.

In its oversight role, PSC monitors the utility's costs to generate and transmit electricity. PSC considers whether these costs were reasonable and if so, it allows the utility to earn a "reasonable rate of return" on these costs.

Under PSC regulations, costs to comply with environmental requirements may be passed on to consumers through a utility's rate base or through a surcharge that appears on customers' bills.

As part of its regulatory process, PSC considers the cost a utility incurs to comply with environmental requirements. A utility might have to purchase emissions allowances or install equipment that reduces emissions to meet the environmental requirements. If PSC determines that these costs were reasonable, the utility may pass the costs on to its rate payers. This is accomplished through one of two mechanisms.

First, a utility may incorporate the costs into its rate base. Periodically, a utility may request that PSC approve new rates. The request and process to evaluate the request are referred to as a rate case. PSC would consider the utility's costs and allow the utility to charge rates that would allow the utility an opportunity to earn a reasonable rate of return on these costs. Greater compliance costs would therefore lead to higher electricity rates. Once the rates are set, they are not updated until the utility's next rate case. As a result, any changes in compliance costs would not be reflected in the utility's rates until then.

The second method that a utility may use to pass the cost of environmental restrictions on to its customers is through the environmental surcharge. The environmental surcharge is applied to each customer's bill to reflect the costs that are associated with compliance, such as purchasing allowances to cover emissions or purchasing equipment to reduce emissions. The environmental surcharge may be updated monthly to reflect changes in the compliance costs.

Currently, utilities receive some allowances at no cost. Without this free allocation, utilities would incur greater costs to comply with the regulations. This would increase the cost of electricity.

Currently, utilities are allocated a number of allowances at no charge, which lowers the utilities' compliance costs. Without this free allocation, the utilities would be required to meet the emissions requirements in some other way. This might involve

purchasing allowances on the market or adopting equipment that would reduce emissions. The utilities would likely incur greater costs of compliance. These additional costs would eventually be passed on to rate payers in the form of higher prices.

By providing the allowances to a utility at no charge, a portion of value of the allowances can be passed on to its customers in the form of lower electricity bills. Those benefiting include the utility's residential, industrial, and commercial customers.

While the benefits of the allowances provided to utilities will likely be passed on to their customers, it is unknown whether the benefits are distributed evenly across the state's population.

It should be noted, however, that while distributing the allowances at no charge to utilities will likely benefit the utilities' customers, it is not clear that the benefits are distributed evenly across the state's population. Currently, allowances of both SO_2 and NO_x are distributed for free to "existing sources," which is defined as those in operation at a certain point in time.[4] Newer sources must purchase allowances or reduce emissions in some other way. Areas of the state that have a relatively greater reliance on newer units might receive relatively fewer allowances. Therefore, customers of utilities that rely on newer units might receive somewhat lower benefits from allowances than customers of other utilities.

Some owners of electric generating units sell part or all of their electricity on the wholesale market, which is not regulated by PSC. This can include firms that produce power exclusively for the wholesale market and utilities' sales made to the wholesale market. Utilities that sell electricity on the wholesale market may use a portion of their allowances to cover the emissions produced from generating this electricity. Other electricity producers would use any allocation they receive in a similar manner. To the extent that these firms receive allowances, they receive a benefit that lowers their cost of complying with environmental regulations, making them relatively more competitive. The regulatory process would not ensure that these benefits are passed on to consumers. The benefits might be received by the firms in the form of relatively higher profits or, if the market is very competitive, the benefits might be passed on to customers.

[4] This point varies across the programs.

Selling All Allowances

One alternative to giving allowances to sources at no charge is to sell all the allowances. Under this situation, the state would receive the revenue from the sale, but electric rates would likely increase as utilities would have to find other options to comply with the environmental regulations.

If the state allocated the allowances in some other manner, the value of the allowances would be distributed differently. One allocation method commonly discussed in the research literature is selling all the allowances rather than just a portion (Tietenberg). In this situation, the government might sell allowances through an auction or through some other process and collect revenues from the sales. Because utilities would no longer have access to these allowances at no cost, electric costs would likely increase. The government however would have additional revenue from the sale of the allowances. These revenues could then be used to fund other state priorities or reduce taxes. Ultimately, how the additional revenues are used would determine who would benefit from selling all the allowances.

If a state participates in EPA's SO_2 trading program, EPA rather than the state is responsible for allocating allowances.

SO_2 allowances are distributed by EPA rather than by the states. While the federal code appears to provide states with some options for meeting the required SO_2 reduction, if the state participates in the trading program, the allowances will be allocated by EPA, not by the state. As a result, states have few options for changing how SO_2 allowances are allocated.

States have more flexibility on how NO_x allowances are allocated. It is unclear how much additional revenue would be generated if all of the allowances were sold.

States do, however, appear to have greater discretion on how NO_x allowances are allocated to sources within the state. It is not entirely clear how much revenue might be generated from selling all the allowances. At the end of 2006, the price of vintage 2007 and vintage 2008 NO_x allowances were approximately $925 and $825, respectively. There is some degree of volatility in the price of allowances, and the price of NO_x allowances has generally been declining. Therefore, it is not reasonable to assume that Kentucky would necessarily receive similar prices.

Other Methods for Allocating Allowances

Any alternative method for allocating emissions allowances will redistribute the value of the allowances from one segment of the state's population to another.

Allowances can potentially be allocated using a number of methods. For example, Tietenberg noted that allowances could be distributed on a first come, first served basis or through a lottery. It is important to understand that under any different allocation, the benefits, or value, associated with the allowances will likely be shifted from one group of the state's population to another. Currently, the majority of allowances in Kentucky are distributed to electric generating units, and the benefits are likely passed on to the utilities' customers in the form of lower rates. Reallocating allowances could cause the cost of electricity to increase. While electric customers would bear the costs of the reallocation, others

might receive the benefits of reallocation. Depending on how allowances are then allocated, these benefits could be redistributed in any number of ways.

Impact of Trading on Compliance Costs

There have been a number of studies looking at how emissions trading affects that cost of compliance.

There have been a number of studies estimating the cost of compliance under a cap and trade program versus other types of policies that are aimed at reducing emissions. Generally, the researchers studying this topic have concluded that trading allowances reduces compliance costs, but the estimates of saving differ across the studies. The differences can occur for various reasons including analyzing data from different geographic areas or time periods. One major reason for difference is the type of comparison made. To determine the savings from trading, a researcher must compare the compliance costs under a trading system to some alternative system that yields similar reductions. Typically, the alternative used is some form of command and control policy in which reductions are required but trading is not permitted.

One study that focused on the SO_2 cap and trade program found that allowing trading resulted in national cost savings of approximately $225 million to $375 million compared to not allowing trading.

Schmalensee and his co-authors compared the cost of compliance under trading to a system that distributed allowances in the same manner but without trading. They estimated that allowing SO_2 trading saved 25 to 34 percent on the compliance costs. This amounts to a savings of approximately $225 million to $375 million per year for the nation.

A 1999 study found that the NO_x cap and trade program resulted in savings of 47 percent.

Teitenberg summarized a number of studies that estimated the cost savings under various cap and trade programs. These studies considered various types of pollutants and covered a number of different geographic areas. The percentage cost savings reported ranged from 6.6 percent for a program that covered sulfates in Los Angeles to 95.7 percent for an early program that covered nitrogen dioxides in Baltimore. Johnson and Pekelney found that a cap and trade program to reduce SO_2 in Southern California resulted in a cost savings of 57 percent. Forsund and Naevdal found similar results for an SO_2 cap and trade program in Europe. In 1999, Farrel, Carter, and Raufer estimated that the NO_x cap and trade program in the eastern United States resulted in a savings of nearly 47 percent.

Economic Impact of Emission Reduction Credits in Louisville

The system of emission reduction credits used to maintain offsets of volatile organic compounds in Louisville operates in a similar manner to cap and trade programs.

The discussion above centered on the major multistate emissions trading programs. As noted in Chapter 1, the Louisville Air Pollution Control District has developed a system of emission reduction credits for volatile organic compounds. Federal law required a reduction in emissions of volatile organic compounds within the Louisville Metro area and prevents major new or modified sources of emissions unless there is a corresponding reduction in volatile organic compounds. A major new or modified source would be one that increased emissions of volatile organic compounds in the city by 40 tons per year. The credits represent a reduction in existing emissions from one source that can be used to offset an increase from another source. As these credits may be traded, this system takes on many of the characteristics of cap and trade programs.

The following section discusses the general economic issues associated with this system. This discussion is based largely on what the regulations permit and how firms might be expected to operate under these regulations. As a practical matter, however, there appears to be little activity associated with these credits. The district reports that no credits for volatile organic compounds have been claimed in some time.

The restrictions on volatile organic compound emissions can make locating a business operation that emits these compounds more difficult and costly in a nonattainment area, such as Louisville, than locating in an area that is in attainment.

The restrictions that apply to nonattainment areas can potentially limit the types of economic growth that occurs. Within a nonattainment area, new major stationary sources cannot locate in the area and existing stationary sources cannot expand significantly in the area unless there are corresponding reductions from other existing stationary sources within the area. These restrictions can make locating a business operation that emits pollution more difficult and costly in a nonattainment area, such as Louisville, than locating in an area that is in attainment.

Allowing emission reduction credits to be created from reduced emissions and then traded to others can create an incentive for existing businesses to reduce emissions and then sell the credits to another business that wants to locate or expand in Louisville.

While the limit on volatile organic compound emissions can make it more costly to establish new businesses in Louisville, the provisions allowing credits to be earned and traded provide some flexibility to the restrictions. In the absence of credits, existing firms may have less incentive to reduce emissions. Under the tradable credit system, however, a firm that can reduce emissions would have an incentive to do so if the credits can be sold for a price that exceeds the cost of reducing emissions. In some instances, owners of a source might have an incentive to reduce operations in the area to lower emissions. This would also result in credits that could be traded to another firm wishing to locate in

Louisville. Whether existing firms reduce emissions by changing their production process or by reducing their level of production, the tradable credits should provide the owners of existing sources of volatile organic compounds with an incentive to "make room" for additional businesses that emit volatile organic compounds. Firms may also receive credits for closing operations even if the decision to close is not related to emissions.

There are a number of provisions within the district's regulations and operations that can potentially affect economic development within the area. These include what happens to unused credits and how these credits may be used.

A business may sell credits to another firm or donate them to the community bank. If the business completely ceases operations in Louisville, its credits will be returned to the community bank.

Some firms that have received credits may eventually leave the Louisville area without using the credits. In this situation, the credits do not necessarily leave the area. As discussed, a firm may sell these credits to another firm that plans to locate or expand in Louisville. In addition, the district's regulations state that if a business completely ceases operations in Jefferson County, the credits will be returned to a community bank. Finally, firms may voluntarily transfer their credits to the community bank.

The Louisville Air Pollution Control Board uses the credits in the community bank as an incentive for firms considering a location in Louisville.

According to district staff, the Louisville Air Pollution Control Board may use the credits in the community bank to attract firms to Louisville. The board works in conjunction with state and local economic development officials to develop incentive packages that include credits to offset emissions in the county.

In 2000, Philip Morris ceased its operations in Louisville and sold its credits to Ford Motor Company.

In 2000, Philip Morris U.S.A. closed the major portion of its cigarette plant in Louisville, allowing the company to hold emission reduction credits for volatile organic compound. These credits resulted from reductions in the amount of emissions at Philip Morris's plant. On June 30, 2000, Business First reported that Philip Morris had agreed to sell 200 credits to Ford Motor Company (Kamuf). Ford anticipated increased production at its plants, which could result in greater levels of volatile organic compound emissions. Philip Morris negotiated the transfer of credits with Ford, but the details of the transfer, including the price, were not disclosed.

If Philip Morris had not sold the credits, the credits would have returned to the community bank when Philip Morris left Louisville.

If Philip Morris had not sold the credits but completely ceased operations in Louisville, the credits would likely have been transferred to the community bank. The credits would then have been available to the board to offer as an incentive to firms considering a location in Louisville. The board could have offered the credits to Ford or some other firm.

Credits received for reduced emissions might be used to offset increases in other counties, including Clark and Floyd Counties in Indiana. This is subject to approval by Kentucky's Division for Air Quality.

It is possible that credits could be used to offset emissions outside Louisville but only in counties included in the Louisville—Kentucky, Indiana nonattainment area. Because Louisville is included within the nonattainment area, a credit represents a reduction in Louisville and the larger nonattainment area as well. Therefore, a credit resulting from a reduction in volatile organic compounds in Louisville could be used to offset an increase in Clark and Floyd Counties in Indiana or Bullitt and Oldham Counties in Kentucky. Using the credits to offset increases in these other counties would require approval from the district.

As a practical matter, there have been no applications to use the credits in Louisville in 13 years. This suggests that firms that emit volatile organic compounds might view other areas outside Louisville as more profitable.

Economic theory suggests that firms might have greater flexibility to expand under a system of tradable credits. District officials have indicated, however, that there has been little activity relating to the credits. In the past 13 years, there have been no applications to develop a major new source or expand an existing source of volatile organic compounds. It is unclear why this is the case. It might be that firms that emit volatile organic compounds do not see the advantages of locating within Louisville as outweighing the costs associated with the environmental compliance. It might also be that newer technology is reducing the need to emit volatile organic compounds.

Conclusions

Pollution often results from manufacturing or using certain products. As the pollution is emitted into the air, it can potentially have adverse health and environmental affects and impose a cost on the general population. Governments attempt to restrict emissions to reduce these costs. Doing so shifts the cost from the general population back to the manufacturers or consumers of products that result in pollution. Recent regulations to control some types of emissions have taken the form of cap and trade programs. These programs set limits on the amount of pollution certain sources may emit and then distributes allowances representing a portion of this limit. These allowances may then be bought or sold.

One important determinant of the economic effect is how the allowances are allocated. Allowances impart a certain value to their holders. The method used to distribute the allowances determines who receives the value associated with the allowances. Most allowances are currently distributed to sources of pollution at no charge.

A second determinant of the economic effect is the ability to trade allowances. Trading allowances provides those sources that face a

lower cost of reducing emissions with an incentive to lower their emissions and sell allowances to sources that face a higher cost of reducing emissions. This can result in lower total costs of reducing emissions than without trading.

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