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# Evaluating Ozone Control Programs in the Eastern United States:

## Focus on the NO<sub>x</sub> Budget Trading Program, 2004

### Executive Summary

#### Emission Reductions

- EPA has developed more than a dozen programs since 1990 to limit ozone formation by reducing emissions of its key precursors: nitrogen oxides (NO<sub>x</sub>) and volatile organic compounds (VOCs). These programs complement state and local efforts to attain the National Ambient Air Quality Standards for ozone.
- Emission trends reflect implementation of these control programs, which began in the mid-1990s. In the eastern United States, NO<sub>x</sub> emissions decreased by 25 percent, and VOC emissions dropped by 21 percent, from 1997 to 2004.
- Control programs successfully reduced NO<sub>x</sub> emissions during the warm summer months, generally referred to as the ozone season. The most recent of those programs was the NO<sub>x</sub> SIP Call, EPA's regulation to reduce the regional transport of NO<sub>x</sub> and ground-level ozone in the eastern United States.
  - All affected states chose to comply with the NO<sub>x</sub> SIP Call by participating in the EPA-administered NO<sub>x</sub> Budget Trading Program (NBP).
  - In response to the NO<sub>x</sub> SIP Call, emissions of NO<sub>x</sub> from the power industry (one of the largest NO<sub>x</sub> sources in the country) dropped significantly after 2002. Other sources did not show this significant drop in emissions.
  - After implementation of the NO<sub>x</sub> SIP Call in 2004, ozone season power industry NO<sub>x</sub> emissions were about:
    - › 30 percent lower than in 2003, when a limited number of states were subject to NO<sub>x</sub> SIP Call requirements;
    - › 50 percent lower than in 2000, before the NO<sub>x</sub> SIP Call was implemented; and
    - › 70 percent lower than in 1990, before implementation of the Clean Air Act Amendments.
  - These reductions occurred despite a shorter-than-normal control period for states participating in the NBP for the first time in 2004 and despite the use of compliance supplement pool allowances—additional allowances issued to help states phase in compliance during the first two years of the NBP.

#### Changes in Ozone

- In most of the eastern United States, reductions in ozone concentrations (adjusted for weather) more than doubled after the NO<sub>x</sub> SIP Call was implemented, beginning in 2003.
- Ozone concentrations declined where EPA expected they would. Areas with the greatest decline in ozone concentrations are near, and downwind of, areas with greatest reductions in NO<sub>x</sub> emissions.
- Because weather conditions can vary from year to year, ozone levels could be higher in years when weather is conducive to ozone formation—even when current emission control programs are working as expected. To get a truer picture of ozone from year to year, EPA adjusts ozone levels to account for the influence of weather.

## **Compliance with the NO<sub>x</sub> Budget Trading Program (NBP)**

- Sources choose from a variety of compliance options to meet the emission reduction targets of the NBP, including reducing generation from certain units, modifying or optimizing the combustion process to reduce NO<sub>x</sub> formation, using add-on controls, or purchasing additional emission allowances from sources reducing below their allocations.
- In 2004, there was close to 100 percent compliance. Of the more than 2,500 units covered by the NBP in 2004, nearly all held sufficient allowances to cover their emissions. Just two units at one facility were out of compliance and subject to an automatic penalty deduction (three allowances for each excess ton of emissions).
- Overall trading activity remained robust in 2004, and allowance prices were lower and more stable than in 2003.
- The level of “banked” (i.e., saved) allowances increased significantly in 2004 as a result of additional sources participating in the NBP and the addition of compliance supplement pool allowances to states’ budgets.
- Sources in the NBP are required to use consistent rigorous monitoring procedures to measure their emissions. In 2004, both electric generating units and industrial boilers passed more than 98 percent of their required quality assurance tests.

## **New Regulations, Additional Improvements**

- While ozone remains a significant problem in many areas of the United States, EPA anticipates additional improvements, including emission reductions from:
  - Continued implementation of the NO<sub>x</sub> SIP Call;
  - Mobile source regulations (new passenger vehicles, heavy-duty diesel engines, and other mobile sources);
  - EPA's Clean Air Interstate Rule (CAIR), which will build on the ozone season emission reductions from the NO<sub>x</sub> SIP Call. In 2015, CAIR, the NO<sub>x</sub> SIP Call, and other programs in the CAIR region will reduce power industry ozone season NO<sub>x</sub> emissions by about 50 percent and annual NO<sub>x</sub> emissions by about 60 percent from 2003 levels. CAIR will ensure that Americans continue to breathe cleaner air by dramatically reducing air pollution that moves across state boundaries in 28 eastern states and Washington, D.C.
  - State Implementation Plans to address ozone nonattainment.



# Introduction

For more than three decades, the U.S. Environmental Protection Agency (EPA) has worked with state, local, and tribal agencies to reduce emissions that contribute to the formation of ground-level ozone. This pervasive pollutant is responsible for a number of serious health and ecological effects in many areas of the United States.

Early ozone management policies focused on reducing ozone by reducing emissions of one of its key precursors, volatile organic compounds (VOCs). VOCs contribute to ground-level ozone formation by reacting with nitrogen oxides ( $\text{NO}_x$ ) in the presence of sunlight.

While ozone levels have decreased substantially since 1980, the downward trend began to slow in the early 1990s. About that time, emerging science indicated that  $\text{NO}_x$  controls, in addition to VOC controls, would reduce ozone levels more effectively across large regions of the United States.

EPA responded by developing programs to reduce  $\text{NO}_x$  emissions, including the  $\text{NO}_x$  State Implementation Plan (SIP) Call, designed to reduce the regional transport of ozone and ozone-forming pollutants in the eastern half of the United States. All states chose to meet mandatory  $\text{NO}_x$  SIP Call reductions through participation in the  $\text{NO}_x$  Budget Trading Program (NBP), a market-based cap and trade program for electric generating and large industrial units.

For this report, EPA analyzed the effectiveness of  $\text{NO}_x$  and VOC control programs designed to reduce precursor emissions and improve ozone air quality. This report focuses specifically on progress made in reducing emissions in the eastern United States under the  $\text{NO}_x$  SIP Call. Analyses of emissions in this report do not include emissions from natural sources.

This report:

- Briefly describes ozone formation and its health and environmental effects, and provides an overview of the major programs designed to reduce ozone since 1990.
- Evaluates the effectiveness of the major control programs by reviewing emission reductions and comparing changes in emissions to changes in ozone concentrations.
- Compares actual changes in  $\text{NO}_x$  emissions and ozone concentrations to those predicted to occur under the  $\text{NO}_x$  SIP Call.
- Examines progress and compliance under the  $\text{NO}_x$  Budget Trading Program, including market activity, allowance banking in 2004, and progressive flow control in 2005.
- Looks at future  $\text{NO}_x$  emission reductions under programs such as mobile source controls and the Clean Air Interstate Rule (CAIR).