Community Action Programs: Blueprint for Program Design
Community Action Programs: Blueprint for Program Design

Regional and State Programs Division
Office of Mobile Sources
U.S. Environmental Protection Agency

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1 INTRODUCTION

Scope of Report

Community Action Programs (CAPs) are voluntary, community-based programs formed from locally-identified goals associated with improving air quality and public health. Known across the country as ‘Ozone Action’, ‘Spare the Air’ and many other names, these programs are designed to address local air pollution problems during the high pollution season. CAPs emphasize educating the public on important air pollution issues (e.g., good ozone versus bad) and the impact that individual activities have on air quality. They define multiple steps that the public, businesses and industry can take to reduce emissions, and use pollution forecasting and public outreach mechanisms to notify participants on days when poor air quality is forecast. The programs are designed to encourage pollution-reducing actions on both an intermittent “episodic” basis (e.g., reduce vehicle trips) and on a seasonal or longer-term basis (e.g., regular car maintenance).

CAPs are typically directed by a coalition of interested government, business and citizens groups. The programs are locally tailored, taking into consideration the pollutants of greatest concern, local sources of emissions, and levels of participation by businesses and industry. There are many different activities required to support and implement a CAP. Areas operating an ozone alert program, for example, must spend a significant amount of time during the early part of the smog season distributing educational materials and conducting workshops for media and employer participants. These activities are crucial to ensure that the general public and local businesses are aware of the program and understand the appropriate steps to be taken during an ozone alert period. The core activities undertaken to develop and operate a CAP are:

- Develop education materials and outreach tools
- Coordinate with local grassroots community and business groups
- Establish control measures/actions participants take on alert days
- Develop accurate forecasting techniques (if episodic)
- Establish and operate a media and business notification network (fax/phone/Internet)
- Collect data on impact of the program

Interest in CAPs has increased dramatically in recent years, as States and MPOs look to identify new ways to address local air pollution problems. To date, over 40 programs have been implemented in more than 20 states nationwide. This increasing interest has prompted the U.S. Environmental Protection Agency’s (EPA) Office of Mobile Sources (OMS) to develop a more thorough understanding of the programs and to assess their effectiveness in reducing emissions. In a series of studies, ICF Kaiser has been collecting data on the episodic control programs currently implemented across the country and evaluated efforts that the areas have made to quantify the impacts of the programs. In addition to determining the impacts of the programs, EPA has also been interested in examining what factors contribute to development of a successful CAP. Identification of these factors will allow EPA to determine what CAPs could eventually qualify for SIP credit. This document describes the
major steps needed to put together a successful CAP and provides criteria that agencies can use to examine and evaluate their own programs.

Implications of Federal Involvement

*Why Evaluate Episodic Programs?*

CAPs are often implemented to improve air quality and public health, but there is a need to quantify what benefits actually occur. CAPs offer additional emission reductions during times when the impact of emission reductions is the most critical. Furthermore, continuing public education may reduce emissions over the long term due to increased public awareness of the air quality impacts of changed behavior. The extent to which CAPs actually yield significant or permanent emission reductions, however, is not yet clear. An air quality planning agency interested in claiming emission reductions from an episodic control program must first be able to quantify those emission reductions before including the program in a SIP attainment demonstration.

While some areas (maintenance, attainment) may not be interested in claiming specific emission reductions associated with their CAP, they may be interested in including it in air quality planning documents such as a maintenance plan. Incorporating a CAP in a SIP would further legitimize the program and possibly open additional avenues for funding (e.g., CMAQ, EPA funding mechanisms). Even though such areas do not need to quantify each emission reduction associated with the program, they should be able to measure the basic effectiveness of the program to show that it meets *minimal standards of performance* and that the federal air quality planning money is being spent effectively.

Agencies that operate CAPs (regardless of their motivations) can gain valuable insight by spending a small portion of their resources in evaluating the program’s effectiveness. In addition to assisting with quantification of program impacts, an evaluation effort can provide valuable feedback on the effectiveness of program components. As with any air quality planning effort that requires staff time and agency resources, periodic evaluation is useful to identify potential improvements for the program. Without an annual comprehensive examination of the effectiveness of all program components, it will be difficult for the lead agency to determine if the program is having any impact and where limited or additional resources should be focused.

*What is Being Evaluated?*

A variety of techniques are currently being used to quantify the impact of episodic control programs. The most common methods used include surveys of public awareness and knowledge, tracking increased ridership or employer vouchers, examination of congestion and parking data, or review of air quality and meteorological data. These data collection and assessment techniques can be categorized into two methods: (1) direct measurement of program impacts and program effectiveness and (2) indirect measurement of overall program impacts.

Direct measurement of a program impact is established when a specific parameter (e.g., number of alert days predicted) can be directly used to estimate the effectiveness of a program component (e.g., accuracy of forecast procedures). Table 1-2 lists the most
common forms of direct data analysis. Analysis of regional air quality or traffic trends, in contrast, is an indirect method which can be influenced by factors outside the episodic program. Factors such as variation in meteorological conditions or special events such as professional baseball games, for example, influence these data and must be accounted for before indirect measures can be used to quantify program impacts. Examples of indirect data sources and some of their confounding factors are listed in Table 1-3.

TABLE 1-2. Direct data sources.

<table>
<thead>
<tr>
<th>Program Component</th>
<th>Quantifiable Goal</th>
<th>Quantification Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public Outreach</td>
<td>Public understanding of air quality issues</td>
<td>Public survey</td>
</tr>
<tr>
<td></td>
<td>Number of participants</td>
<td>Track number of participants</td>
</tr>
<tr>
<td></td>
<td>Awareness of program/agency</td>
<td>Public survey of awareness</td>
</tr>
<tr>
<td></td>
<td>Media hits, accuracy of articles</td>
<td>Track media participation, review articles</td>
</tr>
<tr>
<td>Forecasting</td>
<td>Accuracy</td>
<td>Track performance</td>
</tr>
<tr>
<td>Notification</td>
<td>Public awareness of alert day</td>
<td>Public survey</td>
</tr>
<tr>
<td>Overall Program</td>
<td>Changes in emissions</td>
<td>Alert day survey of behavior</td>
</tr>
<tr>
<td></td>
<td>Changes in business practices, notification of employees, changes in behavior</td>
<td>Business survey, parking lot counts, traffic counts</td>
</tr>
</tbody>
</table>

TABLE 1-3. Indirect data sources.

<table>
<thead>
<tr>
<th>Program Goal</th>
<th>Confounding Factors</th>
<th>Quantification Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improve air quality</td>
<td>Meteorology</td>
<td>Track air quality trends</td>
</tr>
<tr>
<td>Improve public health</td>
<td>Other irritants (allergens)</td>
<td>Track hospital admittance</td>
</tr>
<tr>
<td>Long-term lifestyle changes</td>
<td>Other competing choices, periodic or episodic changes</td>
<td>Survey / focus groups</td>
</tr>
<tr>
<td>Decrease regional congestion</td>
<td>Special events (holidays, sporting events)</td>
<td>Collect traffic counts</td>
</tr>
</tbody>
</table>

Framework for Program Evaluation

Since CAPs vary considerably in terms of program goals, scope and impacts, mechanisms for program evaluation must be flexible. To quantify the impacts of these programs, areas should examine the effectiveness of all actions associated with the operation of an episodic program. These include the activities that occur on an episode day, as well as the public outreach activities required to prepare the public prior to an alert day. Figure 1-1 illustrates the flow of information and actions during an alert day.

In order for a program to be functional and effective, all of the program components (public outreach, forecasting, notification) need to be working together. Therefore, to determine the overall effectiveness of a CAP, program components need to be analyzed individually and as a collective whole. Doing so will allow agencies to identify weakness in their efforts and to focus resources more appropriately. Evaluating the entire program using a standard set of performance measures and accepted techniques also allows outside agencies, such as EPA or FHWA, to support the programs.
FIGURE 1-1. Flow chart of alert day activities.

Layout of Report

The remaining chapter of this report describe the steps required to develop and implement a successful CAP. Chapter 2 discussed the initial factors, partners and resources that agency should consider as they begin to develop these programs. Steps needed to establish an educational baseline and develop public outreach materials are presented in Chapter 3. Chapters 4 and 5 discuss the resource and implementation issues associated with the development of notification and forecasting components of a CAP. Methods that can be used to evaluate all of these components are presented in Chapter 6. Examples from successful programs across the country are included throughout the document and in the appendices.
2 INITIAL PROGRAM DEVELOPMENT

Introduction

One of the key elements of a successful community action program (CAP) is careful planning up-front. Even the best-intentioned effort will be wasted if time has not been spent identifying why the program is needed, building support for the program within the community, and setting realistic goals and limits for the program. Each of these important program development steps are discussed below.

Establishing the Need

CAPs can be implemented for a variety of reasons. Often, motivation for implementation of this type of program stems from local government and business concerns about the air quality attainment status of the area and the restrictions, additional controls, and costs associated with reclassification. Many areas are also motivated by public health concerns and believe that increasing the amount of air quality information available to sensitive populations raises awareness and results in significant health benefits. Finally, areas are looking to innovative programs such as CAPs to educate the public about the negative environmental impacts of traffic congestion and vehicle pollution, and to encourage alternative means of transportation. In order for a CAP to be effective, the sponsors of the program and the public at large must be convinced that the community has specific problems that a CAP can help address, and that it will be a good investment of time and other resources.

Organizing a Coalition of Community Partners

The most effective CAPs have worked diligently with partners in the community to create an organization that leverages local government resources with those in the business and non-profit sectors. CAPs can benefit greatly from teaming with interested government, business and citizen groups early on in the program development process. Participating organizations contribute to the development of a CAP by:

- Lending additional legitimacy to the program
- Donating resources (e.g., financial contributions, office supplies, meeting space)
- Providing community leadership
- Giving access to core constituencies (e.g., company employees)
- Communicating the program’s messages to employees and the community
- Providing program design feedback

Coalition partners often represent many, if not all, of the audiences to whom the CAP messages will be sent, and can provide important ideas and feedback in the design and tone of CAP messages. Coalition members may also be able to better identify the most effective mechanisms for sending CAP messages to various parts of the community. For example, the Chamber of Commerce may have a newsletter or mailing list for local businesses and could
include a pamphlet or factsheet to its members. Similarly, neighborhood groups or the schools can be significant message delivery points. Partnering with local transit agencies can also be beneficial. A coalition operating in Cincinnati, for example, has identified funding to subsidize their transit system during the ozone season. The publicity about the reduced fares is good for the coalition and aids in informing the public about the CAP. The subsidy has also helped to increase bus ridership that appears to be continuing after the ozone season and fares have risen.

Some things to keep in mind when forming a community coalition include:

- Be inclusive - You never know when you may need some specific expertise.
- Be creative - Some partners may have two different goals that can both be met via the CAP.
- Identify groups that will benefit from the economic (e.g., business groups), public health (e.g., schools, hospitals), and environmental (e.g., environmental groups) goals of the CAP and draw partners from their memberships.
- Identify partners that can lend additional legitimacy to the program (e.g., American Lung Association, local universities).
- Identify partners that can provide specific coalition resources (e.g., meeting space; facilitation; graphic design; printing; survey design and evaluation; media access to TV, radio, cable).
- Regularly recognize your partners in your advertising and other public events (e.g., co-sponsorship)

Once formed, the CAP coalition can be subdivided into workgroups with individual missions. Commonly used workgroup categories include:

Education       Develops the education and outreach materials and bring them before the full coalition

Membership      Expands and maintains the membership of the coalition and partner organizations.

Funding         Focuses on grant writing and other funding sources.

Chapter 3 addresses development of educational materials in more detail; establishing program goals and participation and program funding are discussed below.

Identifying Program Goals

All CAPs begin as a potential solution to locally identified problems. Depending on the organization, the coalition members, and the resources they are willing to supply, CAPs can address many different kinds of problems simultaneously. Well-defined CAP goals are vital in order to define appropriate messages which can be designed, delivered, and evaluated against their ability to solve a defined set of problems. Programs designed to include self-evaluation efforts will ensure that the CAP focus their resource in the appropriate areas.

Areas implement CAPs for varying reasons. Figure 2-1 shows the goals identified as number one by various CAPs around the country. As can be seen in the figure, of the areas surveyed, half of the programs stated that public education was the number one goal of the program. The second and third most important goals listed were “Attain/maintain ambient air quality
standard” and “Health Benefits,” respectively. For comparison, Figure 2-2 indicates all of the
goals that were listed as one of the top three in the same survey. While the top three goals
mentioned above are the most common, several programs also noted that economic benefits
and the reduction of traffic congestion and pollutant emissions are important objectives.

CAPs by definition are designed to increase public awareness and affect beneficial behavior
changes on days of poor air quality. To achieve this, many programs enlist the help of the
general public as well as employers and industry. Areas have found that employer support
was critical to the program’s success, since the businesses are in a unique position to educate
their employees about the benefits of participation and have opportunities and mechanisms to
notify them on alert days. As a result, areas have found that employer support is critical to
program success.

While most CAPs are designed to reduce ambient ozone (O₃) levels, programs can also be
developed to target carbon monoxide (CO), nitrogen oxides (NOx), particulate matter (PM),
sulfur oxides (SOx), and lead. From the recent survey of CAPs sponsored by EPA (ICF,
1997), the following is the breakdown of the kinds of participation encouraged by program
type:

- All of the programs encourage public participation
- 100% (2 of the 2) programs targeting CO encourage employer participation
- 20% (1 of the 5) programs targeting PM encourage employer participation
- 97% (30 of the 31) programs targeting O₃ encourage employer participation
- 71% (22 of the 31) programs targeting O₃ encourage stationary source participation
- None of the programs targeting PM₁₀ or CO include a stationary source component

Funding

Historically, areas have used a variety of funding sources to support their programs. Most
use a combination of the following:

- State Environmental, Air Quality, or Transportation Agency Funds
- Taxes and Fees (e.g., state gas tax funds, DMV fees, permit fees, fees on sales of wood
  stoves)
- Congestion Mitigation and Air Quality (CMAQ) funds from the Department of
  Transportation through TEA21 authorizations and appropriations.
- EPA grants (section 105)
- Community outreach and education grants
- Sustainable Development Challenge Grants
- EPA regional grants
- Local Community or Business Foundation Grants
- Support from businesses in both cash or in-kind support.

The status and funding levels of each of these programs may vary (or disappear) depending
on federal or state priorities and Congressional appropriations.
Figure 2-1. Goals ranking #1 in existing CAPs around the U.S. (EPA, 1997).

Figure 2-2. CAP Goals Ranked in Top 3.
The amount funding required to operate a CAP depends on the scope of the program. Some basic pollution advisory programs designed only to forecast pollution episodes and notify the public through the media, for instance, have been implemented with little or no funding. This has been possible through the coordination of various organizations (universities, National Weather Service) to help with the forecasting, the interest and cooperation of the news media, and the dedication of enthusiastic volunteers. Programs which have more demanding goals such as increasing forecasting accuracy and maximizing public awareness through targeted public outreach efforts and media advertising, require significantly larger budgets. A recent survey of existing CAPs (EPA, 1997) found 1996 program budgets ranging from completely voluntary (no funding) to $1 million. The average cost of the 31 programs which submitted budget data was $200,000/yr. The following is a summary of the study’s key findings regarding the levels of funding of CAPs around the nation:

- Funding amounts for the different programs range from no funding to $1,000,000.

- The funding level for the only CO program for which data was available (Phoenix, AZ) is $3,500/yr.

- The average funding amounts received by the 26 ozone programs for which data was available was $210,000/yr. This average does not include the two programs which receive no special funding. The high and low funding values for ozone programs are $1,000,000 for the Baltimore program and $15,000 for the Pittsburgh program. On the average, programs in severe nonattainment areas spend more on implementation of their programs than those in attainment.

- The average funding amounts received by the four programs targeting PM is $256,946. This includes high and low funding values of $900,000 for the Puget Sound Woodsmoke Curtailment program and $22,560 for the Northwest program

- Staffing varies widely, from all-volunteer staffs (as many as 9 volunteers) to 10 full-time paid staff.

It is interesting to note that 62% of the ozone program contacts felt that their 1996 budgets were inadequate to fulfill their defined goals. When program directors were asked how they would spend an additional $100,000 or $200,000 per year, most mentioned improved forecasting and modeling capabilities, developing additional outreach material, and expanding advertising campaigns.

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1 Note that if the Puget Sound program (which has the second highest funding level in the nation of any program) is not included, the average for the three other PM programs is $42,594. All of the PM programs expressed that their 1996 budget was adequate to fulfill the program’s goals.
3 DEVELOP EDUCATIONAL/OUTREACH MATERIAL

Introduction

Education and outreach are the most important parts of any community action program (CAP). Understanding your audiences and developing targeted messages are key tasks to pursue prior to the implementation of a CAP. Building a strong coalition of community partners and working with them to define the CAP goals is an important first step.

Without a clear definition of the program goals and input from relevant stakeholders on the best messages to achieve these goals, CAPs risk wasting limited resources on unfocused education campaigns. The message or messages you choose can be informational, funny, urgent, immediate, long-term, or a mix of each depending on what problems the implementing agencies is considering and what messages can best solve each defined problem and goal.

As discussed in this section, the basic approach to developing outreach materials involves the following key steps:

- Organize key stakeholders to develop and maintain the CAP
- Identify CAP goals and audiences
- Develop an Education and Outreach Strategy and supporting messages and materials
  - Pre-campaign survey to identify the current understanding and awareness
  - Test the messages with Focus groups or test audiences
- Develop a Notification network
- Implement the education and outreach campaign to increase public awareness and understanding
  - Measure the success of the education campaign with pre- and post-campaign surveys
- Identify and use incentives to motivate individuals to take action
  - Use the surveys to test potential incentives and the effectiveness of current incentives
- Measure individual responses to the messages (i.e., changes in behavior)
  - Use surveys to measure willingness to change and actual changes made

Who are the audiences?

The audiences for CAP messages range from everyone in the region to specific subgroups such as: the general public, large and small businesses, employees, drivers, non-road engine users, fireplace users, school teachers and kids.

The Public

The general public is the main audience for most CAPs. Understanding what they already know about air pollution and how they “feel” about the problem and potential solutions can guide the CAP to develop messages that best educate and provide options for the public to
choose from. Many CAPs work with local television, newspapers, and the radio to get the message out to the public. In some areas, Public Service Announcements are used where these media outlets place advertisements about the program for free. In many cases though, the message is played at a less than desirable time.

**Businesses**

Businesses, especially large employers, offer relatively easy access to their numerous employees. One fax or phone call to a large business can notify hundreds or thousands of individuals. In some cases these businesses are partners in the coalition and some offer additional incentives to their employees such as telecommuting options, carpool, or T-shirts. Several businesses have used their internal e-mail systems to notify employees and survey them to identify changes in their behavior.

**Community Organizations**

If community organizations are a participant in a coalition supporting the CAP, one key audience is already at the table to help in the design and delivery of key messages. Depending on the community, the message may need to be translated and tested with some members of the community to ensure that the translated message is meaningful to the local population and effective.

**Drivers**

What is the best way to get the message to drivers? Some areas use billboards along roadways to send the message. In a few, the gas stations are involved and place flags by the pumps to highlight the ozone episode day and alert drivers. Radio spots - either purchased, PSAs, or news stories - are other effective ways to send the message.

**Schools**

For CAPs interested in promoting long-term behavioral changes, outreach efforts to schools should be an important part of their outreach efforts. Children are the next generation of individuals that will participate in emission-producing activity (drivers, nonroad equipment users, etc.). Kids also offer a secondary mechanism to approach and motivate parents to change their behaviors. Mechanisms such as workshops, teacher newsletter/conferences and classroom visits could be used to approach this audience.

**Types of Messages?**

The messages that CAPs present can take many forms. Current research efforts on the effectiveness of various message types are relatively recent and ongoing. CAPs should decide what type of image and motivational tactics to use in the outreach material. Audiences should be able to form a consistent image from examining the various material produced by the CAP. The image can be tied to the program name, logo, and slogans. Once an image and message has been developed it should be used on all outreach materials and
packages of information (business, media, school information packages). Listed below are a few examples of different images presented by program names and motivational slogans.

- Partners for Clean Air - South Bend, IN, Louisville KY and others. *(Community action)*
- OZONE ALERT! - Dallas/Ft. Worth TX, Tulsa OK and others *(Urgent)*
- Smog Alert! - Cincinnati, OH *(Urgent)*
- There’s Something in the Air! - North Carolina Division of Air Quality *(Educational)*
- Spare the Air - San Francisco Bay Area, Sacramento, San Joaquin AQMDs *(Motivational)*
- Lets Clear the Air - West Michigan Clean Air Coalition *(Motivational)*
- Doing Our Share for Cleaner Air - Southwest Pennsylvania Ozone Action Partnership *(Community action)*
- Do Your Share for Clean Air - Cincinnati, OH , North Central Texas COG & others *(Individual action)*
- “Make a difference in your life, not in your lifestyle. Little things you can do to help clean up our air” - Arizona DEQ *(Individual action)*

Program image is also portrayed in the symbols/icons used by the CAP. Some areas present a more urgent message by using a more alarming symbol such as the one shown in Figure 3-1.

![Urgent Program Symbol](image)

**Figure 3-1 Urgent Program Symbol**

The general message portrayed in the symbol is that ozone is bad, today is going to be especially bad, and you need to do something to make it less bad. A more even urgent message, however, would be portrayed by the slogan “ozone alert”. Both of these messages attempt to motivate individuals to make immediate behavioral changes, on the episode day. Other CAPs have used messages that are more benign. These messages seem to take a more long-term approach to encouraging behavioral change. Example of this approach are shown in Figure 3-2.
Figure 3-2. Encouraging Seasonal or Long-term Behavioral Change

Each of these approaches can be useful for CAPs. An alarming message may be effective to alert drivers to change their driving on specific days throughout the season. It may also be the message that alerts schools, nursing homes, and other susceptible populations to the need to limit their outdoor exposure on episode days. Anecdotal information from focus groups held in California that examined various outreach materials raised a number of interesting issues. Some of the respondents thought that simple messages were “too cute”, but others thought that the short messages were “easy to remember”. Respondents also noted that the message portray a clear message with regard to what individuals should do in response to the program and when should those activities occur.

Establish Education Baseline

Determining the educational baseline of a community is an important early step in developing a CAP. An educational baseline is an initial record of the general perceptions and the level of public understanding of local air pollution issues. It serves as an initial guidepost, or reference point, to mark what conditions were like when the program started. It represents a foundation of information that can be used to refine the CAP prior to implementation and to measure the impacts of the program years down the road.

Many areas use surveys and focus groups to measure the educational baseline of a community. Most programs use telephone surveys, a method that allows them to quickly collect information from a large sample of the population. (See Section 6, “Methods to Evaluate Program Effectiveness” for an in-depth discussion of the various surveying techniques available.) Typically, programs will survey the general public prior to, or shortly after, the official start of the program to collect baseline information. Focus groups are used to supplement telephone surveys by some CAPs to collect more detailed information than is possible through a survey. Focus groups can be effective because they bring together a group of people in a forum that encourages discussion and debate between participants, thus promoting greater reflection on the questions and more thoughtful responses.

In addition to determining the educational baseline of the community, survey data can also be used to improve program design, increase the efficiency of outreach efforts, and identify populations that are likely to be early adopters. Data on which mass media outlets are used most frequently by the public could be used to get the most mileage out of limited advertising funds. Information on the types of actions that the public is willing to make to improve air
quality can be used to identify a collection of pollution episode day action items that the public will be most responsive to. Further, data can be collected to determine which incentives are most effective at encouraging public participation.

**Finding Out What Your Audience Has Heard?**

Measuring the level of public awareness of local air pollution issues gives the program an indication of how environmentally-conscious the community is. Since the level of awareness is dependent, in part, on how much the public hears about air pollution problems through the media and other public outreach mechanisms, measuring awareness will help the program determine whether the existing mechanisms are actually reaching the population. Further, the survey effort will serve as an indication of whether the public education materials (i.e. pamphlets) currently being by other agencies are effective at increasing awareness levels. A survey can be used to collect general air pollution awareness information by getting the public’s opinion on the following topics:

- Is there a problem?
- Is the problem getting worse/better?
- Is the problem important to you?
- Should action be taken to remedy the problem?
- Which organizations do you trust?

**Finding Out What Your Audience Understands?**

It is also important to assess the community’s knowledge of air pollution, its sources, impacts and potential solutions. Data on what the public does and does not know about air pollution can be used to tailor outreach materials to educate the public on topics where knowledge gaps exist. A baseline education survey can be used to address the following questions:

- What causes the problem?
- What can you do to address the problem?
- What do you do?
- Would you do more?
- What would it take to do more?

Baseline data on public knowledge levels provide a basis from which to measure any future increases in public knowledge that may be caused by the program and identify early adopters. Early adopters can be identified by examination of survey results. These subgroups, if identified in the survey, are those most willing to change their individual behavior or lifestyle to result in improved air quality. If these groups are identified in a baseline survey, the groups could be targeted by the public outreach efforts.

**Using Survey Techniques to Establish Educational Baseline**

Each of these topics above represents categories of questions that a program may want to include in a survey of the general public. Of the many surveying techniques available to
collect this data (including telephone surveys, mail surveys, travel diaries, in-person interviews, and focus groups), the two used most often are mail surveys and telephone surveys. There are many important considerations to keep in mind when designing and implementing an effective survey. Key issues include maintaining a proper survey length, closely reviewing question wording, maintaining proper question order, incorporating important survey features (i.e. routing instructions), developing an appropriate greeting/coverletter, and developing an effective survey implementation schedule. For a detailed discussion of each of these topics refer to Section 6, “Methods to Evaluate Program Effectiveness”. Also, two sample surveys which incorporate these concepts – one focusing on public awareness issues and the other on travel behavior questions – are provided in Appendices F and H.

**Developing Outreach Materials**

Examples of the many different types of outreach materials developed by CAPs are shown in Appendix C. While many of these materials can be used with different audiences, some must be tailored to the specific needs of targeted audiences. The following sections begin with a discussion of the basic messages which must be presented to all audiences and follow with specific examples of material which should be developed for targeted audiences such as schools and businesses.

**Universal Messages**

**Basic Program Information**

These materials describe the coalition, the partners, and the history and goals of the program. A short description of the problems posed by elevated pollution levels and a short list of things individual can do provide the basic information for an individual to begin being educated and looking for opportunities to do their part. This information is often provided in a pamphlet that can be printed in large numbers and placed throughout the area (e.g., Secretary of State, Dept. Of Motor Vehicles) and delivered by partner organizations in their regular mailings (e.g., utility companies).

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**Use Existing Resources Wisely**

Several speakers at a recent conference on Voluntary Programs noted that coalitions may be best served by buying advertising and using the public service nature of the message to make “deals” such as two ads for the price of one. Designing a public outreach campaign and working closely with media outlets can help CAPs efficiently spend their coalition dollars. Other speakers at the conference mentioned:

*Work closely with local environmental reporters; know who they are, talk to them; and always return their calls.*

*Make the outreach material “news” and highlight the importance to viewers and readers; as news, the CAPs can get informative articles and TV spots that send the message without buying advertising time.*
Air Quality Information.

To motivate individuals to change their behavior, they must first understand that existing air quality levels are, or will be, approaching unhealthful levels. A number of different techniques, using symbols and different words, can be used to portray the severity of air pollution issues to the public. In contrast to PM$_{10}$ or carbon monoxide-based programs, areas trying to explain issues related to elevated ozone levels often have to be particularly careful about the language they use to educate the public regarding air quality issues. For example, the general public is easily confused by the term “ozone” and the difference between ground-level ozone pollution and the ozone layer in the upper atmosphere that protects us from harmful to humans, animals, and agriculture. Exhibit 3-1 provides examples of how a few areas have tried to answer the question: What is Ozone?

Answering Their Questions

CAPs which were recently included in an EPA-sponsored survey universally use a question and answer format for at least some of their documents. These vary in the level of detail that is provided and the tone of the problem. Some are very scientific, while others cater to a broader audience. Several areas have created two sets of information, one geared to adults and the other to young school children. A number have developed significant amounts of educational material that is used as part of school curricula.

Some of the Q&A materials used in various regions present very general ideas about the problem and its origins

- What is ozone?
- Why is ozone bad?
- What is ozone pollution and how does it occur?

Exhibit 3-1. What is Ozone?

Ozone is a gas and the main component of smog. Ozone is formed by the reaction of sunlight and carbon-based chemicals called “hydrocarbons” acting in combination with nitrogen oxides (NOx). The “bad” ozone should not be confused with the protective layer of ozone in the upper layer of the atmosphere which protects the earth from ultraviolet rays.\(^1\)

Though it acts as a protective layer high above the earth, ozone can be harmful to breath. It is the prime ingredient of smog in our cities.\(^2\)

Ozone is a colorless gas that can be found in the air we breathe. Each molecule of ozone is composed of three atoms of oxygen, one more than the oxygen molecule which we need to breathe to sustain life. The additional oxygen atom makes ozone extremely reactive. Ozone exists naturally in the earth’s upper atmosphere, the stratosphere, where it shields the earth from the sun’s ultraviolet rays. However, ozone found close to the earth’s surface, called ground-level ozone, is considered an air pollutant.\(^3\)

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\(^1\) Regional Ozone Coalition, Cincinnati, OH


\(^3\) Baton Rouge Clean Air Coalition
• When and where does ozone pollution occur?
• Where does ground-level ozone come from?
• Where do hydrocarbons come from?
• What causes ozone to accumulate in harmful concentrations near the ground?
• What contributes to the _______ area’s ozone problem?
• Does _________ need to control ozone forming pollution?

Other materials may emphasize the effects of high ozone concentrations:

• Why are people concerned about ozone pollution?
• How does ozone affect human health?
• Does ozone pollution near the ground pose a serious threat to people?
• How does ozone affect plant life?
• Is ozone hazardous to my health?
• What about children?
• What about exercising adults?

Q&A can also be used to summarize strategies for dealing with the problem:

• How can I protect myself and my family from ozone?
• What is being done about the problem locally?
• What is being done about ozone air pollution by scientists and government agencies

As discussed earlier in this chapter, establishing an educational baseline allows you to identify which of these questions are most important to your audience.

• What the public can do to reduce harmful ozone every day?
• What new ozone management strategies are being discussed?
• Why is it so difficult to manage ozone pollution?
• Our air doesn’t look bad, so what’s the problem?
• How can we check the amount of ozone in the air - The Air Quality Index (AQI)

Answers to these questions should be tailored to your area. Once you decide on a term to use (e.g., ozone, smog), it should be used consistently in your materials.

Top Ten Lists

While most programs supply a list of suggested actions that area residents can choose from during the ozone season and during forecast ozone episodes, most are simple list of actions with no hierarchy of activities. Some lists are broken up by types of activities and target audiences. Example categories and suggested actions drawn from various CAPs around the U.S. are presented below.
Take a Moment and Think Before You Turn the Key

- Postpone errands that can wait until the period of unhealthy air passes
- If you must drive and have more than one vehicle, drive only your newest car or truck because newer vehicles pollute less.
- Link all of your small trips into one.
- Make fewer trips. The word “trip” refers to the act of starting your car’s engine. Simply starting your car and backing out of the garage pollutes nearly as much as commuting several miles to work. That’s because your vehicle emits lots of pollution in the first few minutes of operation, before the emission control equipment has warmed up and reaches peak efficiency.
- Share a ride with a friend. Carpool to work or social and recreational activities. Even if a Spare the Air day has not been forecast, get into the habit of carpooling once a week or even once a month.
- Walk or ride a bike for short morning trips, or when-exertion is unlikely. Unhealthy pollution levels don’t usually occur until mid-afternoon or later.
- Where available, use public transit buses or light rail for some trips.

On the Road

- Obey posted speed limits. Your vehicle will operate more efficiently and pollute less.
- Keep your vehicle’s air filter clean. When the air filter is dirty, the engine can’t breathe properly, causing it to operate less efficiently.
- Get regular vehicle tune-ups. This ensures that the engine and emission systems are operating at maximum efficiency.
- Get a Smog Check when it’s due.

Don’t Forget About These Actions

- Don’t use gasoline-powered lawn mowers or leaf blowers. Replace you gas-powered yard tools with electric powered models.
- Use chimney-type or electric charcoal starters instead of lighter fluid when you barbecue.
- Use non-aerosol forms of consumer products. Aerosol versions often contain propellants that lead to ozone formation.
- Postpone using oil-based paints, which contain smog-forming compounds.
- Postpone outings on gasoline-powered boats and off road vehicles.

The Top 10 Reasons
People Cheer for Spare the Air Days

It gives the Pizza Delivery Guy a change of scene, don’t call out for that meal.

Prove your environmental concerns outweigh your materialistic nature: Call your boss and tell him you’re working at home today. (Good luck if you haven’t cleared this already…)

Put off that painting, it’s waited this long already.

Show your family how concerned you are for their health and well-being. Make the kids walk to every little place they wanted you to drive them to. (Clean Air and Exercise, too! Bikes work, too.

It’s a perfect time to share a ride with that good looking new colleague at the office.

Even on the worst Bad Hair Day you have an excuse, "It’s a Spare the Air Day, I couldn’t use the hair spray!"

You really had been meaning to see how those barbecue starter chimneys worked without lighter fluid anyway. (They work better than lighter fluid! Use them all the time.)

Squeeze just one more day out of a crucial deadline, and make your company part of the clean air solution! "I’ll drop that by tomorrow, we’re not driving anywhere today because it’s a Spare the Air Day."

(Just don’t volunteer that it isn’t done…)

"Surf The Web!" It’s environmentally sound. Contains no fumes or aerosols, requires no gasoline, and so far, caffeine isn’t included in starter fluids

And the Number one reason is:

"I can’t mow the lawn today, Honey, it’s a Spare the Air Day!" (make sure you hide your sigh of relief and whatever you do, don’t grin!)
Clean Up at the Office

- Talk to your employer about flexible work schedules and work from home when you can.
- Talk to co-workers about starting a carpool or vanpool.
- Reduce trips during lunch by eating at the office or walking to nearby restaurants.
- Recycle to reduce energy use.

Delivering the Message

Once the CAP has decided what image the program should present and what basic information they need to present; they should examine what mechanisms exist in the community to approach the targeted audiences. Shown below is a laundry list of mechanisms and materials that can be used to send out the message. These are channels that existing CAPs have been found to be effective to certain audiences.

<table>
<thead>
<tr>
<th>Media Material</th>
<th>T-shirts</th>
</tr>
</thead>
<tbody>
<tr>
<td>TV/Radio Print media advertising spots</td>
<td>Paper fans</td>
</tr>
<tr>
<td>TV and Radio Weather reports</td>
<td>Items for Business Packages</td>
</tr>
<tr>
<td>Public Service Announcements</td>
<td>Business workshops/presentations</td>
</tr>
<tr>
<td>Newspaper Articles - Regular Weather Page</td>
<td>Breakfasts/Lunches</td>
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<tr>
<td></td>
<td>Coalition Meetings</td>
</tr>
<tr>
<td></td>
<td>Business packages including:</td>
</tr>
<tr>
<td></td>
<td>program instructions, employee handouts, posters, cards, flags, newsletter articles</td>
</tr>
<tr>
<td>Channel and Items to the Public</td>
<td>School Materials</td>
</tr>
<tr>
<td>Internet Site</td>
<td>Classroom visits</td>
</tr>
<tr>
<td>Hot line/Phone number to call</td>
<td>Coloring/work books (learning tools)</td>
</tr>
<tr>
<td>Community Fairs</td>
<td>Activity planners</td>
</tr>
<tr>
<td>Brochures</td>
<td>Videos/posters</td>
</tr>
<tr>
<td>Factsheets</td>
<td>Contests</td>
</tr>
<tr>
<td>Posters</td>
<td></td>
</tr>
<tr>
<td>Refrigerator Magnets</td>
<td></td>
</tr>
<tr>
<td>Rolodex insert (with hotline)</td>
<td></td>
</tr>
<tr>
<td>Pens</td>
<td></td>
</tr>
<tr>
<td>Car Window items</td>
<td></td>
</tr>
</tbody>
</table>

Targeted Audiences

Media

In most areas, the media serves as the primary distribution channel to the public. It is vital that the outreach material that the media used to develop their own articles and presentations is clear and emphasizes the most important control measures to the CAP. Unique material, such as ozone maps, which can be shown as part of weather forecasts, should be developed in areas that have strong media cooperation/participation with the CAP.

Businesses

Some businesses have been very supportive of CAPs and use their internal communication systems (email, flags) to get the message out. They will need standard material describing the CAP for distribution and materials like flags or posters to fly during alert days. They will often reproduce materials, support contests to award employees who make behavior changes such as switching from individual driving to carpooling. They also do their own part by postponing groundskeeping or batch processing that day. In some instances, businesses can offer transit subsidies to their employees. If encouraged, businesses can also participate in
public education campaigns by cosponsoring media advertisements (which can help the business’s image) and by including standard CAP articles in their company newsletter.

Schools

Many areas have programs tailored specifically to schools. As mentioned earlier, children are often very effective messengers of environmental and health information to their families. Presentations are created with children in mind should be created and offered to area schools. Some material should be informational; other material should focus more closely on the science of air pollution and the environmental and public health benefits of making changes in habits. Learning tools are often developed and include videos, posters, coloring books, workbooks, and contests.

Is the Message being Heard?

Once the messages have been developed, they should be tested on some audiences. Make presentation at a local school and get feedback from the kids. Work with employers to meet with their employees and discuss the information materials and best ways to get the information across. By using a survey at the beginning of their program and repeating the survey through several seasons, a CAP can follow the effectiveness of its outreach efforts and focus its resources most effectively. Figure 3-3 was developed from Cincinnati survey data.

![Graph showing percentage familiar with diesel fuel}

Figure 3-3 - Awareness survey (Cincinnati)

Surveys and focus groups can also be used to get feedback from the public on the CAP program, its message, mascots/logos, and its pollution episode day symbols. Questions can be asked to determine whether the program is recognized and whether it’s message is being interpreted by the public in the way that was intended. Some of these questions include the following:

- Are you familiar with the CAP program?
- Have you heard the CAP slogan?
- What does the CAP program mean to you?
- Have you seen the CAP mascot?
- Do you recognize the Alert Day symbol?
Focus groups are particularly useful for getting input from the public on which symbols and slogans are most effective at conveying the program's message and motivating people to take action. This type of data can be used to improve the symbols and slogans which make up the identity of a CAP. Improving these elements will make the public outreach materials more effective as well.
4 DEVELOPMENT OF POLLUTION FORECASTING CAPABILITIES

This section describes the development of a meteorological and air quality forecasting system capable of providing information to decision-makers to identify, in advance, potential pollution alert days for ozone, carbon monoxide, or particulate matter. Although some forecasting programs in the U.S. have been established to support the issuance of wintertime carbon monoxide and particulate matter alerts (e.g. woodsmoke curtailment), the vast majority of forecasting programs being conducted throughout the U.S. focus on summertime ozone episodes. The discussion below touches mainly on this type of forecasting program.

<table>
<thead>
<tr>
<th>Forecasting System Development</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Identify Resources</td>
</tr>
<tr>
<td>2. Acquire/Examine Historical Data</td>
</tr>
<tr>
<td>3. Develop Algorithm/Methodology</td>
</tr>
<tr>
<td>4. Test, Apply and Evaluate</td>
</tr>
<tr>
<td>5. Implement in Episodic Program</td>
</tr>
</tbody>
</table>

Background

All short-term episodic pollution forecasting approaches in use today rely on statistical relationships between observed meteorological conditions and resulting air quality concentrations\(^1\). To assess and define these relationships, a variety of statistical methods (e.g. regression techniques, empirical formulas, and binary decision classification techniques, such as the Classification and Regression Technique (CART)) have been applied using historical meteorological and air quality data\(^2\). Once these relationships are adequately defined, an algorithm is then developed to “predict” expected pollutant concentration levels (using measured and forecasted data/information). Using this approach, air quality planners have the ability to alert and inform the public (for health reasons) and to implement procedures (voluntary and mandatory) that are expected to lead to a curtailment of activities that affect pollutant emissions.

Agencies implementing community action programs (CAPs) have a variety of options to consider when developing an air quality forecasting system, including: the complexity of the forecasting approach, the frequency with which forecasts are made (once per day, weekdays only?), and the commitment of personnel involved in preparing the forecasts (e.g. in-house

\(^1\) Although not in use today, the application of meteorological/air quality models in “real time” to forecast expected pollutant concentration levels is becoming an increasingly viable alternative to simple statistical algorithms, given the availability of state-of-the-art personal computers with extended memory and high-speed computing capabilities.

\(^2\) An inherent assumption in establishing the relationship between meteorological conditions and ozone air quality concentrations using a long-term (e.g. 10 year) record is that the magnitude and mix of the precursor emissions have remained relatively stable throughout the period. In some areas of the U.S. the effects of growth may be offsetting the effects of pollution controls and motor vehicle turnover. However, certain national regulatory programs (e.g. the 1992 Federal RVP implementation) may have a relatively large effect in reducing precursor emissions and this and other changes in emissions should be kept in mind when developing a forecasting algorithm.
staff, cooperative agreement among multiple groups, or contractor assistance). Most importantly, their options regarding the development, maintenance, and execution of a forecasting system depend, in large part, on the available resources (historical air quality and meteorological data, real-time weather forecast information, staff availability and expertise, and funding). Major steps that must be undertaken in the development of a forecasting system include the identification of resources, acquisition and examination of historical data, development of the specific air quality forecasting technique, and establishment of testing, application, and evaluation procedures. This section describes each of these major steps and discusses some of the choices to be made in developing a reliable system to support episodic pollution alert decision-making.

Identification of Available Resources

Agencies need to acquire sufficient funding for the development of the forecasting algorithm or methodology and to support the implementation of daily forecasting procedures by staff. Additional resources needed to establish and carry out the forecasting program include: a historical data set of local and regional meteorological conditions, a historical air quality data set, a source of local and regional weather forecasting information, and a computer system to retrieve and store the information and perform any necessary calculations.

<table>
<thead>
<tr>
<th>Resources Required for Forecasting System</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; Funding for Development</td>
</tr>
<tr>
<td>&gt; Funding for Personnel to Implement and Carry Out Program</td>
</tr>
<tr>
<td>&gt; Historical Meteorology and Air Quality Data</td>
</tr>
<tr>
<td>&gt; Source of Local Weather Forecasting Information</td>
</tr>
<tr>
<td>&gt; Computer System</td>
</tr>
</tbody>
</table>

Personnel

In view of the many tasks involved in developing and implementing a forecasting system, a decision must be made as to the most effective source of expertise for each task. If the staff and expertise are available in-house, then the entire forecasting system could be developed and implemented without outside assistance. For some forecasting systems, the costs of daily implementation are considerably less than the initial creation of the system. In these cases, the agency may only need to obtain outside expertise while developing the system.

As an example, in many cases agencies interested in developing a complex algorithm-based forecasting system do not have the specialized mathematical, chemical, and meteorological expertise in-house necessary to develop the system. In this case, it may be more appropriate to have the algorithm developed by an outside resource specializing in this area, such as a local university, an alternate government agency, or a private consulting firm. Agencies using a more simple forecasting approach, such as analyzing current meteorological conditions with an understanding of how these variables influence ozone production in the local area, often do not need outside assistance in system development or implementation. Typically, only one or more meteorologists or air quality engineers are all that is necessary to operate systems of this type.

Once established, daily pollutant forecasting can be performed by one individual or through a team effort of multiple individuals/agencies. For example, staff from the University of
Maryland work in cooperation with staff from the Maryland Department of the Environment to provide ozone alert day forecasts for the Baltimore and Washington D.C. areas. For the Cincinnati area, meteorologists from the local television stations work jointly with staff from the Hamilton County Department of Environmental Services to provide ozone forecasts for the local “Do Your Share for Cleaner Air” program. A conference call is held each afternoon to discuss the expected weather conditions for the next day and to make a decision for calling an ozone alert.

Staffing resource decisions associated with development of a forecasting program should consider the following:

1) staff availability,
2) potential interagency cooperation, and
3) daily staff demands.

If a program is established, personnel must be made available for a certain length of time during a certain designated period each day. A forecasting program, if created as a joint effort of multiple groups, must establish clear roles for individuals/groups, formalize lines of communication, and set up a relatively strict daily schedule for conferences/deliberations and decision making. Forecast personnel must be provided a formalized schedule to retrieve the necessary real time and forecast information, execute the forecasting algorithm or otherwise prepare the forecast, analyze the results, and provide a decision to those in charge of broadcasting the alert.

**Data Availability**

As the initial step in the forecasting algorithm development, an assessment should be performed of the various types of data available, as well as the sources for these data. The three types of data needed to develop and implement a forecasting system are:

1) historical data,
2) real-time observational data, and
3) forecast data

Historical data are used to develop the forecasting methodology (e.g., a statistical forecasting algorithm), while the real-time and forecast “data” are used as input to the pollutant forecasting technique. The specific technique or algorithm will depend on the availability and reliability of the meteorological and air quality data for the area. For both types of data (meteorological and air quality), either actual physical observations or forecast values may be used. If real-time or near real-time information is not available on-line, it may be difficult to provide forecasts in a timely manner. For example, an ozone forecast must be prepared by the early afternoon of the day before the alert day. Consequently, the reporting time for observed (or forecast) data variables must be sufficiently prior to the forecasting time to allow for incorporation of these variables into the forecast. If this is not the case, then that particular datum is unlikely to be of any utility in the ozone forecast.
Meteorological Data

A major collector of meteorological data is the National Weather Service (NWS), whose data are archived by numerous agencies. The National Climatic Data Center (NCDC) is a major source of these archived data. In addition, other sources of data may be available. Often, the local air quality monitoring network also supports the collection of meteorological data. Real-time data are generally available from the local NWS office or the local air quality monitoring network, or are obtainable on-line through the Internet. All data must be available and accessible in time for inclusion in the air quality forecast preparation.

Air Quality Data

The major source of historical air quality data is the EPA Aerometric Information Retrieval System (AIRS). More information on the AIRS system is available on the EPA website at http://www.epa.gov/airs/airs.html. In addition, real-time observational data should be available from the local monitoring network on-line and may also be used in the forecasting.

Data Completeness/Applicability

As they develop a forecasting methodology, CAPs should consider the analysis of historical data, preferably, a long (e.g. 10 years), recent record of meteorological conditions/air quality concentrations. Analysis of these data provides insight into the causative factors related to pollution events as well as the basis for the development of conceptual and/or statistical models. In addition, a long record allows for the “capture” of pollutant trends. It should be noted that if a particular variable were historically available but is no longer available, inclusion of the variable in the forecasting system would be inappropriate. (For example, cloud cover was routinely monitored in the past. As many of the systems have become automated, cloud cover has been dropped from those variables recorded.) The converse is also true, even if a particular variable is currently available, if it were not historically available, it would be difficult to incorporate this variable when designing the forecasting system.

In addition to examining data availability, CAPs should assess data completeness. Incomplete data records can cause forecasting systems to incorporate surrogate variables, which in turn impose possible errors into the system. With the change in National Ambient Air Quality Standards (NAAQS) 8-hour ozone standard, it is crucial that the data be of sufficient completeness to allow for the computation of an 8-hour ozone average concentration following EPA guidelines which require seventy-five percent completeness on an annual, daily, and 8-hour basis. Prior to the use of the data, they should be checked for accuracy and representativeness.

Computer Resources

An additional consideration in establishing a forecasting program arises from the need for certain physical resources. The implementation of the ozone-forecasting algorithm will minimally require obtaining current meteorological and/or air quality data on a daily basis.

Obtaining these data may be as simple as making a series of phone calls, or it may involve the electronic transfer and processing of data from a number of different sources (requiring computer hardware, modems, and programming skill). If an algorithmic system has been
adopted, then computational facilities will be required. The complexity of these computational facilities may run from that of a handheld calculator, to a PC type machine to a workstation, depending on the complexity of the algorithm adopted. If meteorological forecasts are being performed as part of the ozone forecasting procedure, then additional computational facilities may be needed. These procedures generally require work-station or higher end computing machines. Depending on the in-house available resources, it may be advantageous to have one or more of the necessary tasks performed by an outside agency or group.

**Development of a Forecasting Methodology**

As noted above, the development of a forecasting methodology will depend on the complexity of the area, the availability of the data, and the availability of resources to support the program. For example, a very complex algorithm requiring high-end computer capabilities could be developed for a particular area, but it would be of little use if the required computer resources were not available on a daily basis to perform the necessary calculations. From a practical standpoint, however, most ozone forecasting programs being conducted today rely on relatively simple statistical algorithms that require only small to moderate amounts of computing capability readily available on most personal computers (PCs).

In developing a statistical-based forecasting algorithm, a principal consideration is the representativeness of the historical data record. If an unprecedented meteorological/air quality event occurs that is not recorded in the historical database, then regardless of the quality and quantity of the data used to develop the forecasting system, those conditions would not be properly accounted for. Consequently, a representative historical database is requisite to the successful creation of a predictive algorithm. While complete information is not always available, a database can be assembled such that the relevant informational content is maximized. Specifically, this database should be constructed such that: (1) the spatial distribution of the data is sufficient to resolve local ozone formation as well as pollutant recirculation and transport and (2) the data record is of sufficient length to include representatives of the different types of episode and non-episode days that are likely to occur within the area of interest. The principal remaining issue is how these data are used to construct a predictive algorithm.

The major task CAPs must address is to find an algorithm that determines current and next-day daily ozone concentration based on available meteorological and air-quality data for the air basin for the current (partial) and previous days. The fundamental difficulty in this task is that any data set will include more than one set of variable dependencies (e.g., different meteorological conditions can give rise to similar distributions of ozone concentrations). A simple example of this principal involves a simple function of one variable, such as

\[ f(x) = y. \]

The functional relation \( f \) between \( x \) and \( y \) can be determined from a data set composed of \( x \) and \( y \) values, with standard regression and curve-fitting techniques. A more complicated problem is one where there is a multivariable functional dependence, such as

\[ f(x_1, x_2, \ldots, x_n) = y. \]
This type of relationship can be dealt with using multivariable regression techniques since a vast amount of literature on the effectiveness and robustness of these techniques exists. Note, however, that a key feature of this relatively complex problem is that there is a single functional relation assumed between the independent and dependent variables. Regression

**Forecasting Techniques used in the Baltimore-Washington Area**

The University of Maryland (UM) and the Maryland Department of the Environment (MDOE) have conducted the ozone forecasting for the Baltimore-Washington area in recent years. The current day’s surface meteorological data (surface wind speed, wind direction, temperature, sky cover, relative humidity) for the Baltimore-Washington International Airport are obtained. Upper air observations at the Dulles International Airport for temperature and wind speed at the 850 mb level are also obtained for the first step. Next, information from the raw model output of the Nested Grid Model, the Medium Range Forecast Model, and the ETA Model for other variables is obtained. The local National Weather Service forecast is consulted, particularly to determine maximum temperature. Information on the previous day’s maximum ozone concentration is also gathered.

The data are then used in a regression model that predicts the daily maximum ozone concentration in ppbv. The regression model was developed using ozone/surface and upper-air meteorological data for the period May–September for the years 1987–1993. It is important to note that the regression model uses statistical procedures to correlate meteorological parameters with ozone parameters. It does not take into account annual increases or decreases in emissions, nor the spatial or temporal variations in emissions of ozone precursors.

The regression model requires the input of the daily maximum and minimum surface temperatures, afternoon sky cover, relative humidity (at 0900 UTC), surface wind speed at 1000 and 1800 UTC, wind speed and temperature at 850 mb, and the length of the day, to make a forecast of the daily maximum ozone concentration. The short-term regression forecast model requires daily maximum and minimum temperatures, morning and afternoon sky cover, relative humidity (0900 UTC), surface wind speed at 1800 UTC, inversion temperature, wind speed at 850 mb, length of the day, and maximum ozone concentration on the previous day. In addition to providing the input variables to the model, the forecaster also makes corrections for any known deficiencies in the regression algorithm. The forecast of the daily maximum ozone concentration is actually done twice. One forecast, the long-range (24-hour) forecast is issued at 1500 EDT. This is updated the following morning by the short-range (12-hour) forecast issued at 0900 (EDT). On weekdays, these forecasts are made independently by forecasters at the UM and at the MDOE. The forecasts are discussed and a consensus forecast is then issued. On weekends, forecasts are prepared at the University of Maryland only.

Once a daily maximum ozone concentration is predicted, a “color coded forecast” is prepared for dissemination to the public. This entails assigning a color to represent the predicted ozone concentration. The Code Red forecast is assigned when the predicted ozone concentration exceeds 125 ppb. This code is equivalent to the “Warning” level in standard forecasts made by the National Weather Service. The Code Orange forecast is assigned when the predicted ozone concentration exceeds 110 ppb. This code corresponds to the “Watch” level of the National Weather Service. The Code Yellow forecast corresponds to the 60–110 ppbv range, and the Code Green forecast corresponds to less than 60 ppb.
techniques employed for this type of problem typically generate some subset of all the possible functional forms, and then use an optimization measurement to select from all the possible functions, the one deemed "best" by this measure.

Examples of these techniques go under the names of multivariate analysis, principal-component analysis, single value decomposition, maximum entropy methods, linear prediction, etc. However, even when a single functional relation is appropriate, these techniques may not be fully effective at elucidating extremely complex functions, such as those with extremely sensitive dependencies, or discontinuities (including that which describes the relationship between meteorology and air quality).

These analytical methods assume that the data set can be characterized by a single functional dependence. However, the functional dependence on temperature for predicting ozone concentration on a hot, wet day, for example, is not the same as that on a hot, dry day. Humidity fundamentally changes the functional dependence on temperature. A standard regression technique would just weigh one of the variables by the other, say

$$f = r^q$$

$t = \text{temperature}$
$q = \text{specific humidity}$

so that as specific humidity increases, the temperature dependence decreases. This may work provided that the functional relationships remain fairly simple and analytic, but in practice this does not work (is not computationally feasible) when the relationships become more complex. On the other hand, if the true relationship is something like

$$f = t \text{ when } q < 8 \text{ g/kg},$$
$$f = 2t \text{ when } q > 8 \text{ g/kg},$$

then the regression derived single function would be something along the lines of

$$f = 1.5t$$

for all values of specific humidity, which would always be wrong. When the dependent data set has discrete subsets, the standard tools which apply to continuous sets may be inappropriate.

Similar problems have been recognized in other fields, and some of the most difficult problems in information processing are currently being reexamined fruitfully with algorithms which explicitly acknowledge that the data set is composed of discrete classes. Particularly difficult problems, where classification algorithms are providing novel solutions, include speech recognition, visual image, data compression, medical imaging, medical diagnosis, and weather forecasting. The state-of-the-art statistical tools being used to solve these problems are decision-tree methodologies, with the prime example being the Classification and Regression Tree (CART) algorithms developed by Brieman et al. (Brieman, 1984). This particular set of decision-tree algorithms has been extensively tested, and shown to provide nearly optimal classification for a variety of data sets and applications. The CART analysis technique was originally applied in the early 1980s to the South Coast Air Basin (Los Angeles) to support ozone forecasting for the area. An ozone-forecasting algorithm developed using the CART approach was also recently developed and tested for the Baton Rouge, Louisiana, severe ozone nonattainment area.
In attempting to properly forecast ozone production in a particular region, a balance must be found between the possibly divergent characteristics of the physics of ozone formation and the regulatory framework. Since many ozone forecasting exercises are intended to prevent the future designation of non-attainment in a region, it may be advantageous in the design of the forecasting system to focus on less severe ozone concentrations than those which exceed the regulatory limit. In addition, a typical ozone forecast must be called at some point prior to the actual daily maximum observed ozone concentration, which necessitates that the relationship between the maximum observed ozone concentration at the time of the forecast and the later daily maximum be understood. This also indicates that it may be advantageous in design of the forecasting system to focus, or at least account for, maximum concentrations values less than the regulatory limit.

Following the development of an appropriate forecasting algorithm, a remaining task is transforming this algorithm into a reliable and easy-to-use-forecasting tool. Preparation of a daily forecast will involve

1) The acquisition of on-line meteorological and air quality data (real-time and forecast information);

2) Execution of the statistical algorithm,

3) Analysis of results and decision regarding alert, and

4) Dissemination of results.

The algorithm must be written to efficiently accept input data (on-line or typed) in a timely manner to meet the established daily schedule set for computation, analysis, and decision making. The details of the daily procedures and schedule to be followed in conducting the forecasting should be established in a formal air quality forecasting protocol so that all parties involved are aware of the elements of the program, how alert decisions are arrived at based on the results of the forecast, and the timing of the decisions so that other parties can be properly notified.

Test Procedures

Testing and evaluation of the algorithm are important before relying on the algorithm/methodology to accurately predict pollutant events. Testing and evaluation are recommended before a newly developed algorithm is put in place as part of an episodic program. Evaluation must consider the ability of the methodology to accurately predict non-episode days (low ozone concentrations) as well as episode days (high ozone concentrations), Figure 4-1. Two primary concerns are underprediction of peak concentrations for episode days (resulting in the misidentification of an exceedance day) and overprediction of peak concentrations for non-episode days (resulting in the false identification of an exceedance day). Because of the desire to avoid unnecessarily notifying the public, the latter case is of most concern.

<table>
<thead>
<tr>
<th>Daily Forecasting Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; Acquire Data</td>
</tr>
<tr>
<td>&gt; Execute Methodology</td>
</tr>
<tr>
<td>&gt; Make Decision</td>
</tr>
<tr>
<td>&gt; Send Out Message</td>
</tr>
</tbody>
</table>
Figure 4-1 Forecasting Accuracy in Baltimore for 1995

An ongoing evaluation of the results throughout the implementation phases of the forecasting system will need to consider the overall effectiveness of the episodic program. If the program is effective, a reduction in the predicted ozone concentration will be expected and a forecasted ozone exceedance day may become a non-exceedance day. Thus, evaluation of the forecasting methodology may be complicated by these favorable results.
5 DEVELOP NOTIFICATION SYSTEM

The ability to forecast pollution episodes a day in advance creates a window of opportunity for CAPs to notify the public about preventative actions that can be taken. Once a forecast is made, however, an effective means by which to notify the general public is needed — a pollution alert notification system must be established for this purpose. A notification system is a set of established procedures for transmitting a message, through various channels, to the public and participating organizations. A well-designed notification strategy can be the difference between large-scale community action on pollution episode days or virtually no action at all. It is a crucial element of a program’s success since the level of community action is dependent, in part, on how effective a program is at spreading the word. This section reviews the key elements needed to design a comprehensive public notification system.

Identify Participants

Figure 5-1 is a schematic diagram of a typical pollution alert day notification process. The boxed items represent participants in the notification system. These include employers, stationary sources and the media which help to transmit the alert message to their employees and the general public. The circled items represent the channels of communication through which the pollution episode day message, represented by the connecting lines, is transmitted. As seen in the figure, once a pollution alert is declared, the message is sent from the implementing agency, via various routes, to participating organizations, their employees, and the general public. Once received, it has the potential to affect behavior at the organizational and individual levels.

Pollution alert messages are designed to notify the public (especially sensitive populations such as children, the elderly and people with respiratory ailments) about poor air quality and to encourage changes in personal behavior that brings about immediate emission reductions. Unlike general public education messages, a pollution alert notifies the public about an immediate public health threat. Alert messages convey a sense of urgency, making them effective mechanisms for motivate people to change established behaviors. Programs typically couple the alert message with suggested actions that can be taken by individuals to do their part to reduce air pollution.

Developing a List of Channels to the Public

The ultimate goal of a notification system is to convey the pollution episode message to as many people as possible. The more channels of communication used the greater the likelihood that a significant portion of the population will become aware of the pollution episode. There are many communication channels through which programs can notify the public about a pollution episode day. Some of the main communication channels include:
Figure 5-1 Routes of Communication

- Local media outlets (newspaper, radio, TV)
- Phone hotlines
- Internet web page
- Display signs at business, local agencies and gas stations
- Changeable highway signs

Many mechanisms can be used by the program with limited investment and on-going costs by coordinating with the controlling authority (i.e. TV networks, newspapers, highway sign officials, etc). Others such as web pages, gas station signs and phone hot lines, may require an initial investment in resources to develop. The types of channels used by a program will depend on their availability within a community and the budget constraints of the program. Even though the types of channels available for use will vary somewhat by locality, most should be available in every community. Areas designing a public notification strategy will need to consider which communication channels are available, which are feasible given the agency’s resource constraints and which will reach the most people in a timely manner. Each of these considerations must be weighed to determine which method(s) of communication should be used by the program.

The communication channels with the greatest potential to reach the most people are the local newspapers, radio and TV. One or more of these mass media outlets are regularly accessed by most citizens making them ideal for exposing a large percentage of the population to the episode alert message. Surveys completed by many areas indicate that TV reaches the most individuals. The results of a survey indicating which media respondents recalled hearing about the program is shown in Figure 5-2. To enlist media participation program staff will need to describe the program to each media contact and discuss coordinating notification procedures. The media contacts should be informed of the normal schedule for forecasting and be notified of any timing issues or problems with the forecasting team as soon as possible. Other advantages of using local media outlets are that they frequently transmit the pollution alert message as a public service at no cost to the program.
Mass Media

Each of the mass media outlets (newspaper, radio & TV) informs the public in different ways as dictated by their medium. The main ways a newspaper can communicate the alert message to the public are to discuss it in an article, or to display an alert symbol on the front page or on the weather page with the Pollutant Standard Index (PSI) report. Since newspapers have layout limitations, and episode days are typically forecast during the afternoon, a predetermined space on the front page or weather page should set aside with a couple of simple icons which identify each type of alert day (green symbol - all clear, red symbol - alert day). Radio stations can broadcast public service announcements, or include an alert notification in news stories or in traffic reports. TV stations can mention the alert day in the

![Figure 5-2 Media Distribution in Dallas (Information on Episodic Program)](image)

news reports or the weather reports. When the alert notification is included as part of the weather forecast (pollution forecast), colorful maps or animation can be used to visually indicate which areas are to be ‘under alert’. An example of an ozone map is shown in Appendix H.

Businesses and Employers

Companies, businesses and other participating government agencies can display signs, flags and placards to notify the public on pollution episode days. Notification symbols can be displayed via ozone flags, stickers and placards in windows or inclusion on business signs. Gas stations can also participate by place signs on gas pumps to remind people of the pollution alert. How effective these display signs are at reaching the public will depend upon how widely they are distributed to and displayed by local organizations. Each of these methods will require monetary expenditure to design and print the display materials.

Support of the business community is an important part of a successful program since people are more likely to take action on episode days if their employers are encouraging them to do so.
These organizations can also communicate pollution episode information to their employees. Many programs have recruited businesses and agencies to participate in spreading the word to their employee, since they have unique mechanisms (such as company-wide broadcast messages via email and voicemail) which can reach and influence a large number of people quickly and efficiently. The number of people reached will depend upon how many organizations are recruited to participate and the number of employees at these organizations. Support of the business community is an important part of a successful program since people are more likely to take action on episode days if their employers are encouraging them to do so. (Some employers also offer incentives for their employees to participate, such as offering free or discounted transit passes, offering free lunches, or coordinating car/vanpools with other employees.) These factors make employers an important channel of communication through which alert information can be disseminated.

Direct Communication

Telephone hotlines, email and Internet web pages and the main communication channels that allow the implementing agencies to communicate directly to the public. The main advantage of these channels is that there are no limits to the amount of information that the agency can make available to the public. Common topics covered by hotlines and web pages include current air quality levels, area-specific pollution forecasts for the next day, information on actions that people can take to reduce pollution, and other pollution and health information. The internet can also be used to notify telecommuters of alert days via internet email. The Internet is a versatile medium for distributing information since it offers an interactive environment with pictures, graphics, sound and animation. Web developers can also include links to other sites to take advantage of other sites with shared educational material or information on available transit options. Some programs have developed ozone maps to graphically show projected ozone levels in the region. Web sites can also contain information to support other notification channels. The sites can be used to explain what the notification symbols displayed by the newspaper or TV station mean.

Telephone hotlines and Internet web pages are both ‘passive’ communication channels, meaning that, compared to some of the other channels they require more effort on the part of the public to access the information they contain. These channels are typically used by people who have a personal interest in knowing what the air pollution level is and are willing to make the efforts to find out by calling the hotline or connecting to the web page. In contrast, many of the other channels (e-mail, TV, radio, etc.) are more ‘active’ in the sense that they communicate the message to people who wouldn’t normally make the effort to find out what the air pollution situation is. The main drawback of passive communication channels is that fewer people are reached through this mechanism. One final consideration is that programs choosing to utilize these channels will require some capital expenditures to set up these systems and keep the information current. Despite these issues, telephone hotlines and web pages are among the most effective means to communicate detailed up-to-date information to the public. As a
result, they have become standard means by which CAPs convey air pollution alert information to the public.

A final type of message sign being used with increasing frequency is changeable highway signs. More and more metropolitan areas are building changeable roadway signs along busy freeways to provide important traffic information to drivers. Some CAPs have coordinated with a transportation agency to have the pollution alert message displayed on days of poor air quality. This method holds promise as an effective, low-cost way to reach the freeway commute population.

Establishing Notification Routes

Once the means through which to communicate the pollution alert messages have been chosen, procedures must be developed to ensure that it is transmitted efficiently via all channels to participating organizations and the general public. Most programs rely on a phone and/or fax tree to send out pollution alert information simultaneously to all participating organizations and to the media. Some send the alert off to grassroots groups and business coalitions that further distribute the alert message via their own fax trees to other interested parties. These fax and phone trees have proven to be efficient means to distribute the pollution messages from the episodic control program administrative level down to the participating groups that are an integral part of the alert notification distribution system.

As discussed, the local media (newspapers, TV and radio) are a crucial part of the distribution system since these are the main channels of communication through which most of the public can be reached. To enlist the participation of the media, episodic control program staff will have to meet with media contacts to describe the program and discuss what participation in the program entails. Once a commitment from the media is secured, the implementing agency will need to negotiate with the administrators of the media outlets chosen about how the alert message will be conveyed.

In newspapers the alert message can be conveyed by mentioning the alert day in an article, by declaring the alert day in the Pollutant Standard Index (PSI) section, or by prominently displaying a recognizable symbol that represents poor air quality. The later option, displaying a recognizable symbol, is one of the most effective ways to quickly convey the pollution alert message through the print media. (More discussion of alert day symbols is given in the Chapter 2) Ideally, a pollution alert symbol should be placed on the front page of the paper where it is highly visible. The beneficial results, in terms of public exposure to the message, yielded from prominent coverage of the pollution episode day in the newspaper and other media cannot be underestimated. With this in mind, program administrators should try to secure the most favorable media coverage as possible. This may involve negotiating with the newspapers over such issues as the placement of the pollution episode day message and symbol and the amount of space given to the topic.
The implementing agency will also need to discuss the procedures for notifying the public with local radio and TV stations. Radio stations have several means by which to relay alert information to the public. These methods include broadcasting public service announcements or including alert notifications in news stories or in traffic reports. Disk jockeys and radio personalities can also mention the status of air pollution alerts during their discussions on the airwaves. (On pollution episode days, talk radio stations could devote a segment of the show to air quality.) CAPs may able to negotiate with radio administrators to influence how frequently the alert day is mentioned. Also, the radio stations may be open to suggestions about the content of the message. CAPs should see how much information the stations are willing to broadcast. Some stations may be willing to mention the alert day at regular intervals as well as discussing actions that people can take to do their part to reduce pollution.

On television, alert day messages are typically discussed in the weather report and/or in news reports. Once again, the more coverage given the issue, the greater the number of people will be exposed to it. Hence, program administrators should negotiate to receive as much coverage as the station will allow. Topics such as what the newscasters will say about the pollution episode during the broadcast may be negotiable. At a minimum, newscasters should mention that there is a pollution alert because of forecasted high pollution levels. Additional useful information that could be mentioned includes actions that people can take to reduce pollution, such as using alternative modes of transportation and postponing landscaping activities that use small engines. Finally, if the program has a pollution episode day symbol the television broadcasters may agree to display it on-screen (in one of the corners of the screen) during the broadcast. This would familiarize the public with the symbol and further help to spread the message.

One final note regarding transmission of alert day information to employees from participating companies or via the internet. As mentioned previously, companies can inform their employees of a pollution episode day using a company-wide broadcast message via phone mail, e-mail, or internal memo or by displaying alert day placards or flags throughout the office in places employees will notice. Staff from the agency implementing the program should discuss resource limitations with companies to determine if the company wants to take primary responsibility for notifying their employees or if the agency should use a list-serve to contact employees through internet email. In some cases, use of both mechanisms would help to ensure the distribution of information. However, if the company and the agency are both using email to track employee participation, some double counting could occur if employees are responding to both systems.

**Developing Materials**

A final important aspect of creating an efficient notification system is the development of materials to assist in conveying the program's message. Many programs have developed an alert day symbol to inform the public on the air quality conditions, such as a traffic light with green, yellow and red lights. In the example of a traffic light, a red light would suggest poor air quality and would convey the message that the community should 'stop' polluting activities that day, such as using gas-powered garden equipment or barbecues. A green light means that the meteorological conditions are not conducive to pollution formation and that all activities can continue unabated. Symbols such as these are easily recognizable to people and can serve as powerful tools to convey information to the general public. Other materials which can assist in spreading information to the general public include an Internet web page.
with links to an ozone map which visually shows where high ozone levels are expected. With
the Internet becoming an increasingly important source of information for people, a web page
can be an efficient way for computer-oriented individuals to learn about local air quality.
Examples of notification systems included on web pages are included in Appendix D. Like
the alert day symbol, the ozone map is another visual tool to quickly convey information that
is easily understood to people. Finally, many programs have developed posters and flags
with the program symbol and logo to increase public awareness of the program and educate
the public about actions they can take to reduce pollution. Consistent use of the same
symbols in these materials is important to emphasis the message. Typically these materials are
displayed in public buildings and by participating organizations and agencies.
6 METHODS TO EVALUATE PROGRAM EFFECTIVENESS

Framework for Program Evaluation

Increasing interest in CAPs has prompted the U.S. Environmental Protection Agency’s (EPA) Office of Mobile Sources (OMS) to begin developing a more thorough understanding of the programs and assessing their effectiveness in reducing emissions. In an October 1997 memorandum, EPA issued guidance on incorporating voluntary mobile source emissions reduction programs in SIPS. An important requirement for SIP eligibility is the commitment on the part of states to monitor, evaluate, and report the impacts of the program on emissions and remedy any shortfalls between actual and projected reductions. Table 6-1 lists this and other major issues that EPA must address before they can consider granting SIP credit to these programs. Appendix A includes the complete October 1997 memorandum.

Table 6-1 SIP Credit Issues

<table>
<thead>
<tr>
<th>Issues and Requirements for SIP Credit under Section 110</th>
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<tbody>
<tr>
<td><strong>Enforceable Measures</strong></td>
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<tr>
<td>No enforceable limitations</td>
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<tr>
<td>Voluntary compliance / market based</td>
</tr>
<tr>
<td>Emission reductions, but voluntary</td>
</tr>
<tr>
<td>TCMs traditionally granted credit w/o enforceable limitations</td>
</tr>
<tr>
<td><strong>Air Quality Data / Emission Reductions</strong></td>
</tr>
<tr>
<td>Data collection and methodologies must demonstrate emission reductions</td>
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<tr>
<td>Inclusion of nontraditional methods (surveys, behavioral change data</td>
</tr>
<tr>
<td>Inclusion of forecasting methodologies</td>
</tr>
<tr>
<td><strong>State Law and Authority</strong></td>
</tr>
<tr>
<td>Framework for local implementation and enforcement</td>
</tr>
<tr>
<td>Federally enforceable when adopted in SIP</td>
</tr>
<tr>
<td>Demonstrates permanence</td>
</tr>
<tr>
<td>Program must be funded and implemented by state</td>
</tr>
<tr>
<td><strong>Funding</strong></td>
</tr>
<tr>
<td>Must have adequate personnel and program funding to demonstrate permanence</td>
</tr>
<tr>
<td><strong>Minimum Program Criteria for Voluntary/Episodic</strong></td>
</tr>
<tr>
<td>Being developed</td>
</tr>
</tbody>
</table>

What are areas interested in evaluating?

Unlike other regulatory-driven programs, CAPs are community-based programs formed from locally-driven needs and goals. Despite the unique development paths taken by the different CAPs, the following are the top three goals consistently reported by programs around the country:

1) Educate the public
2) Attain/maintain air quality standards, and
3) Improve public health.

These goals dictate what, if any, monitoring of results takes place and the kinds of overall program impacts that are evaluated by each agency. Many areas are interested in developing methodologies to quantify the emission reduction impacts of their programs and have tried several
methods to collect data for use in emission calculations. Other areas, more interested in continued maintenance of air quality standards or educating the public, focus more of their resources at monitoring air quality levels or surveying the public.

Program Evaluation

Despite the different goals that agencies can be targeting with their program, it should be noted that these goals are only achieved as the outcome of all components of the episodic control program working together. The four major components of an episodic control program include:

- Public Outreach
- Forecasting
- Notification
- Evaluation

There are specific actions and goals associated with each of these major program components, as shown in Figure 6-1. All of these activities, which support the program and prepare the public for an alert day, and the activities which occur during episode days need to be completed competently for an episodic control program to be functional and effective. The ultimate goal, or impact, of the program can not be achieved unless all of the program components are working together. Figure 6-2 illustrates how some of goals of CAPs can finally be achieved on an alert day. We could quantify these impacts by examining the final outcomes associated with operation of an episodic program on an alert day. Quantifying these impacts is desirable when we are interested in measuring performance of specific goals, such as estimating emission reductions for SIP credit. However, as these programs are quite complex, performance of the program, as measured by specific goals, could vary considerably from alert day to alert day. Thus other ‘measures of performances’ are needed to fully evaluate a CAP.
Figure 6-1. Actions and Goals associated with major program components

As mentioned above, an episodic program is composed of many different components which must work together to influence individual’s behavior and achieve program goals. To evaluate the effectiveness of the overall program and understand how the program components interact, we must examine the effectiveness of each program component. Evaluating the effectiveness of all parts of the program is important to understand the basic functionality of the program so that the program can be improved. Examining each component separately allows agencies to identify weakness in their efforts and focus resources more appropriately.

In some cases, even though all of the components of a program may be working together, a program might not achieve its goal of influencing individual’s behavior due to the intervention of outside causes. To illustrate with the previously mentioned, parent/child analogy, despite the parents’ day-to-day efforts to educate and influence their children to ‘do the right thing’, their effectiveness as parents can not always be measured based on their children’s behavior in specific situations. Sporadic outside influences may affect individual’s behavioral choices. With episodic programs, as is shown in Figure 6-2, these outside influences could be associated with special events, such as sporting events or holidays (Fourth of July). On these occasions, individuals may increase activities such as driving, even though they are aware of the impacts of their behavior on air quality. Thus individual ‘standards of performance’ for each program component, as well as overall program performance goals should be considered when evaluating a seasonal/episodic control program.
Figure 6-2. Alert Day Activities

What can be measured?

Whether we are trying to determine the effectiveness of the individual program components or trying to measure improved air quality levels, we must first determine which steps or program components have quantifiable data that can be compared to program goals. A few examples of questions that can be asked to gather data concerning program activities during alert days include:

1. How many media contacts and employers are notified via a fax tree?
2. How many employees are notified?
3. What changes in individuals’ (general public or employee’s) behavior occurred during the alert day? (What percent of the general public are changing behavior? What specific behaviors (driving) are being changed?)
4. How many businesses are changing their business practices? What are those changes?

While some of these questions can be tied back to program components, additional questions can be posed regarding some components’ effectiveness on an on-going basis. Examples include:

1. Is the public aware of the existence of the seasonal/episodic program? (percent of public)
2. Does the public understand what to do during an alert day? (What actions are participants prepared to take?)
3. Is the program being coordinated with all local, significant businesses/employers? (Who is participating and ready to receive notification?)
4. How accurate are the forecasting procedures? (Are bad air quality days missed? Are the forecasting procedures too conservative?)

Quantifiable data, where it can be tied back directly to program actions and goals, can serve as a direct measure of the programs and that’s component’s effectiveness. Examples of these
‘direct measures’ for each component are shown in Table 6-2. Other indirect measures for both the components and the overall program can not be tied directly back to an agency action. These measures, such as changes in air quality or transit ridership, are affected by too many outside influences (e.g., weather) to allow for direct comparison. Many of the measures that are associated with the overall effectiveness of the program at reaching specific goals are indirect measures.

<table>
<thead>
<tr>
<th>Program Component</th>
<th>Quantifiable Goal</th>
<th>Quantification Method</th>
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<tbody>
<tr>
<td>Public Outreach</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Public education</td>
<td>Public understanding of air quality issues</td>
<td>Public survey / questionnaire</td>
</tr>
<tr>
<td>- Community outreach</td>
<td>Large number of participants</td>
<td>Track number of participants</td>
</tr>
<tr>
<td>- Media outreach</td>
<td>Public awareness of program/agency</td>
<td>Public survey of awareness</td>
</tr>
<tr>
<td></td>
<td>Significant No. of media hits,</td>
<td>Track media participation,</td>
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<tr>
<td></td>
<td>Accuracy of articles</td>
<td>Review articles</td>
</tr>
<tr>
<td>Forecasting</td>
<td>Accuracy</td>
<td>Track performance</td>
</tr>
<tr>
<td></td>
<td>Consistency</td>
<td>Track performance</td>
</tr>
<tr>
<td>Notification</td>
<td>Public awareness of alert day</td>
<td>Public survey</td>
</tr>
<tr>
<td>- fax tree</td>
<td>Businesses &amp; media aware of alert day</td>
<td>Fax survey</td>
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<tr>
<td>Program Evaluation</td>
<td>Understand program strengths/weakness</td>
<td>Examine compare survey data from year to year</td>
</tr>
<tr>
<td>- self evaluation</td>
<td></td>
<td>Combine alert day survey data with emission assumptions.</td>
</tr>
<tr>
<td>- SIP evaluation</td>
<td>Calculate emission/aq impacts</td>
<td></td>
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<tr>
<td>Overall Program Impacts</td>
<td>Changes in behavior/emissions</td>
<td>Alert day survey of behavior</td>
</tr>
<tr>
<td>- alert day activities</td>
<td>Changes in business practices, notification</td>
<td>Business survey, Parking lot counts,</td>
</tr>
<tr>
<td></td>
<td>of employees, changes in behavior</td>
<td>Telecommute info.</td>
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</tbody>
</table>
impacts are associated with the public outreach/education components of these programs. Some agencies have also reported anecdotal but unproved evidence that implementation of seasonal/episodic control programs may assist state and local regulatory agencies with their implementation of regulatory programs such as Inspection and Maintenance. Increased levels of public awareness - associated with seasonal/episodic outreach efforts - on general air pollution issues and their personal role in solutions, may fostered a greater acceptance of regulatory programs. Survey data on public willingness to participate in certain activities and long-term changes in trends in transit ridership, for example, could be used to measure “seasonal” impacts.

In contrast to episodic behavioral changes, long-term and seasonal behavior changes can be used to estimate permanent changes in regional emission levels. Long-term behavioral changes are associated with reduction and permanent changes in individual or stationary source activities. Episodic changes, in contrast, are often associated with delaying activities (such as putting off mowing the lawn). Many of these activities, and their associated emission levels, will eventually occur in the air basin. Therefore the emission reductions associated with these activities should be treated appropriately. Reduction in emissions associated with purely episodic behavior changes can only be applied in episode-specific modeling applications. Seasonal or long-term emission reductions could, however, be applied to seasonal emission inventories.

National Comparisons

A comparison of surveys completed by areas across the country showed that surveys differ significantly in their approaches; critical factors such as survey timing and survey wording, which impact the results of the survey, are not handled in a uniform manner by each agency. Because these factors can bias the survey results, the survey results often cannot currently be compared from one survey to another, and certainly cannot be compared from one program area to another. For EPA to be able to compare CAPs or their impacts, from area to area, a national survey or standard questions to be included in behavioral surveys, must be used by all areas. Sample surveys and survey questions are presented in the appendices and discussed in later sections of this chapter that areas could use to help EPA develop a better understanding of the impacts of these programs across the country.

Tools Available for Measuring Effectiveness

Some of the data and assumptions required to quantify the impacts of seasonal/episodic programs are available to air quality planning agencies, but much of the key data—such as the level of public awareness and corresponding levels of emission-producing activity—are most readily obtained through surveys. Several survey techniques are used to collect data on public opinion and changes in people’s behavior: telephone surveys, mail surveys, travel diaries, in-person interviews, and focus groups. Because seasonal/episodic programs are voluntary, with no mandatory requirements for individual behavioral changes, no other techniques exist besides market research/survey techniques to assess behavioral changes. Some areas have attempted to use proxy data, such as parking lot counts, to gain some level of insight into program effectiveness. These efforts have been largely unsuccessful.

It is difficult to attribute changes in trends data, such as ridership, ambient air quality levels, or public health (e.g., emergency room visits) to the operation of an seasonal/episodic control program since many factors affect these data. Nonetheless, these data are still valuable to track since they can provide supporting evidence of the effectiveness or ineffectiveness of a program. The systematic collection of data - regularly and uniformly - will improve the quality of evaluation efforts. In addition, there is also a high likelihood that continuing efforts
to collect and evaluate these data will increase their value as evaluation tools and techniques improve.

**Survey Instruments**

Several surveying techniques are used to collect data on public opinion and changes in people’s behavior: telephone surveys, mail surveys, travel diaries, in-person interviews, and focus groups. Determining which surveying instrument to use, however, will depend upon the data collection objectives, and the project’s time and money constraints. The target group (general public, companies, or employees) that data will be collected from may also influence which survey instrument is used. Each of the surveying techniques has strengths and weaknesses which should be considered before one is chosen. Some of these instruments are designed for a very limited, specific purpose. For example, travel diaries are effective at collecting detailed trip data on individual travel behavior but are not useful tools for collecting information on changes in public awareness levels over time. Most of the methods, however, are more versatile, allowing both awareness data and travel data to be collected. Each of these is discussed briefly here.

**Mail surveys and telephone surveys** are the most frequently used survey instruments since they allow a large sample of people to be surveyed in a shorter amount of time and for less money than other surveying techniques. Long the industry standard, mail surveys have been used for years to collect social science data. The main advantages of mail surveys over other surveying instruments include no interviewer bias, less expensive, allows confidentiality, and allows more time for respondent to respond. However, there are also several disadvantages of mail surveys such as possible lower response rates, slower response time, administrative complexities, no control over environment, and inflexible design. **Telephone interviews** have several appealing features including interaction between interviewer and respondent (allows questions by the respondent to be answered on the spot), the ability to poll a large sample quickly, and with the advent of Computer Aided Telephone Interview (CATI) technology automatic data entry and quicker data analysis. The main drawbacks of telephone surveys include limitations on the complexity of questions, tighter restrictions on the amount of the respondent’s time that can be taken, and the possibility that the way an interviewer asks questions can influence how a person responds thereby biasing the results.

**In-person interviews and focus groups** are typically used to obtain more detailed information from a smaller number of people. Both methods allow face-to-face contact between the interviewer and the participants. The main advantages of these two methods are that the environment is controlled, interviewer can get a feel for respondents and their attitudes/biases, questions can be easily answered, props and exhibits can be used to convey ideas or ask questions, and more time is available for detailed responses. Disadvantages with these approaches include higher cost, more time to implement, limited sample sizes and possible interviewer bias. Focus groups are unique among the surveying methodologies because they bring together a group of people so that questions can be asked to individuals or to the group as a whole. The discussion and debate between participants can promote greater reflection on the questions and may lead to more creative solutions.

A survey of episodic control programs in 1996 by ICF Kaiser showed that of all the methodologies discussed, the one used most by program’s to collect data on public awareness and program effectiveness was telephone interviews. The main reason cited by many implementing agencies is that more than any of the other survey techniques, telephone surveying allow the collection and entering of a large amount of data very quickly. This is a
powerful selling point for implementing agencies trying to perform program evaluations under tight deadlines. Several episodic control programs have supplemented data collect from their telephone interviews with data collected from focus group sessions. The focus group allows them to obtain more detailed information that was not possible to collect from the telephone surveying and to use props and exhibits if necessary.

Factors for Improving Response Rate and Data Accuracy

Several steps should be taken in the design and implementation of survey instruments to ensure that data collected using surveying techniques are as accurate as possible. In the
survey research literature there is much discussion of ways to maximize the survey response rates, to help ensure that a representative sample of people is surveyed, and to ensure that participants respond accurately. Survey techniques have some limitations. Only a small portion of the entire population can be included in a survey; the results from a small subpopulation must be extrapolated to the larger population. Any non-respondent bias, or problems from choosing a non-representative sample will be extrapolated in the survey results. Scheduling and timing issues also occur with survey implementation. Surveys given on different days of the week can produce different results. A survey given on the same day, with a different population subgroup, could also produce different results due to differences in the subgroup. All of these limitations should be understood whenever survey results are examined. While it is beyond the scope of this study to discuss each of these at length, some key factors which should be considered are discussed here.

Recruiting Survey Participants

Once a representative sample of the population is chosen each prospective participant must be notified (in-person, via telephone, or by mail) that they were selected and encouraged to participate. A greeting or cover letter is typically created for this purpose. A well thought-out greeting is an important part of survey research as it can make the difference between high and low response rates, which, in turn, affects the representativeness of the data collected. An effective cover letter or greeting is particularly important when recruiting is performed over the telephone or via the mail. While the greetings for each surveying technique differ somewhat, all should include the following basic information:

- A short description of the research being done and how the information will be used – mention the societal benefit expected from the research
- Let the respondent know that their participation is important since they are one of only a small number of people chosen to be interviewed
- Reassure the respondent that all answers provided are confidential
- If applicable, mention any incentives being offered for participation
Special considerations must be made when implementing telephone or mail surveys. For mail surveys the content of the cover letter is crucial. The cover letter should convey the information discussed above in a clear and concise manner. Other information that is often put in cover letters include a telephone number that the respondent can call to ask questions, a personal signature, and giving thanks and appreciation for the respondents' time. Another technique used to increase the response rate of mail surveys is to include a postage-paid envelope for returning the survey. Finally, it is best if the survey is affiliated with a neutral and respected organization and the cover letter is printed on the letterhead of that organization.

Telephone surveys also require custom greetings to recruit survey respondents. For telephone surveys, however, keeping greetings very short and to the point is of paramount importance. The low tolerance the general public has for telephone solicitation requires that greetings be concise. This dictates that only the crucial information discussed above should be included. The interactivity of the telephone medium, however, allows inquiring respondents to obtain additional information if it is desired.

Survey Design

The data collected from surveys is only as good as the survey instrument used. Some basic guidelines on survey question organization and content should be followed to help improve response rates and ensure that meaningful data are collected. It is widely recognized that the length of a survey and the corresponding time commitment required for the respondent to complete it are among the most important factors which determine whether a respondent will participate or not. Generally speaking, the shorter the survey the greater the likelihood that people will participate. When designing a survey, however, a balance must be achieved between keeping the survey instrument short enough so that it doesn't unduly burden the respondent, and collecting enough data to be able to perform rigorous analysis. Survey length is more critical for telephone and mail survey instruments than for in-person interviews and focus groups. It is believed that respondents are willing to spend more time on mail surveys (as much as 20-30 minutes) than they are to answer a telephone survey (10 minutes or less).

Questions content is also an important factor which influences response rates and the quality of the data collected. In general, survey questions should be designed to be clear and relatively easy to answer. Questions should not be asked which require respondents to perform complex calculations. To maintain a logical flow throughout the survey, questions on a similar topic should be grouped together. To maximize the likelihood that respondents will complete the survey once started, the question order should progress from general to specific, easy to more difficult, and non-sensitive to sensitive. As a general rule, sensitive issues such as age,
education level and income should be asked last.

The order and wording of questions also greatly influences response rates and the quality of the data collected. Some basic guidelines on survey question organization and content should be followed to help improve response rates, reduce respondent bias, and ensure that meaningful data are collected.

**Figure 6-3. Examples of Poorly-designed Survey Questions**

<table>
<thead>
<tr>
<th>Have you taken action or behaved differently based on hearing or reading about the Air Quality Index / Ozone Alert?</th>
</tr>
</thead>
</table>

From the wording of this question it is clear to the respondent that they are being asked to make a response to reduce air pollution. Responses to these questions are more likely to include actions to improve air quality than those that are worded without bias. Any mention of the episodic control program should always come at the very end of the survey and should never be included in the same question that is collecting information on behavior change. To eliminate response bias, this question should be asked in two parts: the evening of the Spare the Air day. The first part asks whether they changed their driving, and if they respond yes, the second part asks why they made that change (e.g., did they make it in response to the Spare the Air program?)

Other questions, such as the following, invite bias by being poorly-worded:

<table>
<thead>
<tr>
<th>Did you drive your car or truck today less frequently than you normally do?</th>
</tr>
</thead>
</table>

While, at first glance, the built-in bias may not appear obvious, a closer look shows that by only asking whether the person drove *less frequently* this question hints at the type of response that is desired. This question can be re-written, as follows, to eliminate any bias as to the preferred answer:

<table>
<thead>
<tr>
<th>Did you drive your car or truck today more frequently, less frequently or the same as you normally do?</th>
</tr>
</thead>
</table>

**Survey Implementation**

The schedule with which surveys are implemented can greatly affect the accuracy of the survey results. Factors such as the time of year that the questions are asked, the day of the week (weekday or weekend), and whether or not it is a pollution episode day must be considered when putting together a survey. Many different types of implementation schedules can be used to collect data for different types of comparisons. To gather information on the effectiveness of the outreach components of a program, areas can perform a survey early in the ozone season, which represents “before implementation” (baseline) data. Another survey can be performed later in the ozone season, giving an “after implementation” reading and allowing a before/after comparison. Data collected from these two surveys can be used to do a before / after comparison.

Similarly, an ‘on episode day’ / ‘off episode day’ comparison can be developed to examine alert day impacts. To quantify changes in behavior (that lead to emission reductions or changes in
exposure levels), surveys should be completed on specific seasonal/episodic days to ensure that the data are accurate and that respondents’ memories do not influence the results of the study.

While many survey implementation schedules are possible, the following examples of survey comparisons are available to examine program impacts and reduce survey bias.

- Normal day vs. alert day
- Beginning of season vs. end of season
- Single day episode vs. multi-day episode

**Procedures for Direct Measurement of Program Effectiveness**

**Standards of Performance**

As stated earlier, agencies implementing CAPs can benefit by completing an internal evaluation of their programs and using the findings to make program improvements. Outside agencies, such as EPA, that are responsible for overseeing air quality programs and setting national guidance, also have a need to evaluate CAPs. Many agencies have also expressed interest in obtaining emission reduction credits for their programs. For an area to include the program’s benefits in a SIP or conformity demonstration, EPA would have to accept the methodology used to estimate the emission impacts. Furthermore, while techniques to quantify the programs do exist, the accuracy of these estimates over time depends upon continued implementation of an effective seasonal/episodic control program. Therefore the remaining portions of this section, presents specific examples for determining program impacts and ideas on minimum standards of performance that EPA can use to evaluate CAPs. These standards of performance adopted will be critical to determine which programs have demonstrated success and deserve official EPA recognition and/or SIP credit.

Program performance standards must provide clear guidance for areas that want to calculate emission benefits, but also be flexible enough to allow areas that are only interested in gaining legitimacy for their programs to meet minimal standards. To ensure that emission estimates calculated are realistic, areas interested in calculating emission reductions must have a program that is sufficiently developed and includes all of the core elements associated with a successful program (e.g., public outreach, notification, forecasting, program evaluation). Each of these elements, in turn, must be evaluated annually to confirm the overall benefit of the program. Thus, these programs must include actions to quantify the effectiveness of program elements.

Generally speaking, the main goal of CAPs is to improve air quality by educating the public about local air pollution problems and actions they can take to reduce emissions. Several general criteria can be used to gauge whether a program is achieving these objectives:

1) Is public awareness of the program and its objectives increasing or continuing at a high level?
2) Is public awareness of air pollution issues increasing or continuing at a high level?
3) Are the program components working together sufficiently well?
4) Is the public reducing emission-producing activities on an episodic or seasonal basis?
To evaluate the impacts of a seasonal/episodic control program, data must be collected in all of these areas. Unless the public education and awareness programs continue, behavioral changes monitored in one year may not continue to future years. On the other hand, unless the implementing agency is able to correctly forecast alert days and notify the public in a timely manner, the program will not reduce emissions. Finally, unless public behavior is monitored in an unbiased manner, the agency can only guess at potential emission reductions. Each of the following sections discusses methods to evaluate the performance of these programs. Suggested deminimus levels of effort are all given for each major program component.

Public Outreach

Successful public outreach efforts ensure that all of the members of the community (businesses, agencies, general public) are aware of the seasonal/episodic control program and understand what actions they can contribute during seasonal or episodic high pollution periods. Since these efforts are typically quite costly (see Figure 6-4), particularly if mass media (TV, radio, and newspaper advertisements) are used to educate the public about the program, most areas are interested in determining if the public has ‘heard’ the message. Unless the public has heard and understands their contribution to air pollution in the air basin, it is unlikely that they will take any steps to reduce or delay emission producing activities. Thus successful implementation of this step is probably one of the most important cornerstones of a successful seasonal/episodic control program. With this in mind, minimal efforts needed to support a solid outreach program include:

- Outreach (meetings, workshops) with business, media and community groups
- Development of a clear, consistent message, including:
  - Program name, identifiable symbol, slogan
  - Suggested actions to reduce air quality
  - Web site with air quality, health information
  - School educational materials
  - Business/employer materials
  - Media package
- Tracking (through annual surveys, focus groups) of public awareness and education

![Figure 6-4 Budget Breakdown](image)
Tracking Public Education and Awareness Levels

Agencies can collect survey data to track the effectiveness of their outreach and education programs. These surveys can be given to the general public and other targeted audiences included in the outreach (businesses, community organizations, media, schoolteachers, and employees). Areas usually combine awareness and education surveys together since the topics are closely related. An example set of public awareness survey questions that agencies can use to develop their own customized survey is included in Appendix E. The survey in Appendix E is designed in a telephone interview format. It includes samples of the many different types of questions that are used to collect data on public awareness levels by CAPs around the nation. Programs should not use the survey as is, but rather as a basis for developing an instrument tailored to their data collection needs. To accomplish this, a program can start by selecting the sets of questions are relevant, tailoring the questions and response choices to local needs, putting the questions in logical order, and providing the survey formatting and question routing necessary in order for respondents to easily complete the form.

For illustration on the types of public awareness questions used, a few examples from surveys given in Baltimore, Sacramento, San Francisco and Dallas are shown below. These examples are given to show the different types of questions that agencies might want to include or exclude from the example survey. These questions collect information on the public awareness level of the program (familiarity with the slogan, symbol), public perceptions of local air quality problems, and the overall effectiveness of the outreach efforts.

<table>
<thead>
<tr>
<th>Have you heard of Ozone Alert/Spare the Air/Ozone Action?</th>
</tr>
</thead>
<tbody>
<tr>
<td>In the past week, have you seen or heard anything about air pollution in our metropolitan area?</td>
</tr>
<tr>
<td>Could you describe what you saw or heard?</td>
</tr>
<tr>
<td>In the past week, have you seen or heard any air pollution slogans or symbols?</td>
</tr>
<tr>
<td>What did the symbol mean?</td>
</tr>
<tr>
<td>Would you say that air pollution or smog is... (serious, somewhat serious, not a problem)</td>
</tr>
</tbody>
</table>

Survey questions on public education generally try to determine if the public understands what contributes to air pollution problems and what they can do to improve air quality.

<table>
<thead>
<tr>
<th>Which of the following (automobiles, trucks, buses, airplanes, industry) do you feel is the biggest contributor to air pollution in your area?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Please tell me the things you could do to keep smog out of the air - Don't prompt - (take the bus, carpool, conserve electricity,...)</td>
</tr>
</tbody>
</table>

These general awareness and education surveys should be given at least once at the beginning and end of the pollutant season (summer time for ozone) on an annual basis. Since public outreach efforts are often the largest in the beginning of the season, completion of a midterm surveys might prove useful to determine if the outreach efforts need to be maintained at a high level throughout the season. Annual surveys are required to determine if education efforts, especially those targeted at children, are having any long-term impacts. Consistency in questions (from year to year) is important to be able to estimate trends.
The survey results from most areas indicate that the public is more willing to participate in certain types of control measures than others. For example, survey results indicate that respondents are more willing to curtail use of consumer products\(^1\) and lawn and garden tools, rather than to curtail driving. It is important to understand whether the public is reluctant to curtail certain activities due to lack of knowledge or inconvenience. To address this, agencies should to identify the segments of the population most willing to participate in the program and the most effective media channels:

<table>
<thead>
<tr>
<th>Question</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Where did you hear the slogan “Spare the Air” (radio, TV, newspaper, billboard, employer)?</td>
<td></td>
</tr>
<tr>
<td>Which activities are you willing to change in order for this area to have cleaner air (driving behavior, use of gas-powered yard equipment, use of consumer products)?</td>
<td></td>
</tr>
<tr>
<td>If you are not willing to change anything - why?</td>
<td></td>
</tr>
</tbody>
</table>

Specific groups (e.g., mothers between the ages of 30-40) can be identified as “early adopters” if questions related to age, gender, income level, educational status and employment are included. These early adopters are generally defined as individuals who recognize air pollution problems, agree that air pollution has negative consequences, agree that they contribute to the problem, and are willing to take action. Not only can surveys and focus groups be used to track the effectiveness of the public outreach material, they’re also the best tool available for agencies to determine why individuals participate in specific behavior changes over others and what incentives can be used to augment this willingness.

**Notification (fax trees, media hits)**

As discussed in section 6, notification efforts typically utilize fax tree services to reach business and media participants and telephone hotlines and Internet web sites to reach the general public. The businesses and media then notify the general public using their own communication channels (i.e., TV news and weather, email). Minimal standards for notification should include:

- Use of a fax tree to notify business and media,
- Transmission of a consistent message (using symbols, colors, or words) to clearly indicate different levels of air quality,
- Routine\(^2\) transmission of air quality information to all participants.

**Tracking effectiveness of notification procedures**

Areas interested in quantifying overall program impacts (emission reductions) will likely be notifying many media outlets and businesses on alert days. Many programs report business participation levels ranging from 100 to 1,500 companies. To estimate the effectiveness of their notification mechanisms programs can:

1. Develop and distribute ‘fax’ surveys periodically to the media and companies to determine if the fax tree is working and contacts understand the message

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\(^1\) For a program to be effective, especially for areas where area sources are a significant portion of their emission inventory, the seasonal/episodic control program can have more impact in reducing ozone levels if emphasis is expanded to include activities other than driving.

\(^2\) Businesses or media will be more apt to respond quickly to notification if the procedures are routine (i.e. daily transmissions).
2. Include questions on alert day surveys to determine how the general public and participating employees are hearing about alert days (e.g., TV, radio, employers),

3. Include questions on alert day surveys to determine if participants understand the meaning of alert day notification symbols.

Since emission reductions from participating companies and prompt transmission of the alert day information to the media are important to the effectiveness of an episodic control program, agencies must ensure that all participants (media/companies/employers) are notified of the episodic event in a timely manner. To measure this, an annual fax survey, concerning the accuracy and completeness of the fax tree service, could be given. A survey of this type was given in Milwaukee to determine if the fax tree service was operating as requested:

- Using the correct phone numbers,
- Notifying the correct personnel,
- Notifying the personnel in a timely manner and
- Providing all of the information needed by the participating companies.

These types of surveys can be implemented on an annual basis, or more frequently, if the fax tree service vendor changes. Deficiencies in the fax tree service were noted in the Milwaukee survey and improvements were incorporated into the overall program.

Information regarding the awareness and understanding of the general public and secondary contacts (employees) included in the notification channel can be obtained by the inclusion of questions in alert day surveys. Some areas, such as Dallas, have estimated that the episodic program notification reaches approximately 600,000 employees. These employees are contacted by their company via email, alert day flags or posters. Since the companies agree to be responsible for notifying their employees when an alert is declared and agree to educate the employees about actions they can take to reduce pollution on those days, the agency doesn't have direct contact with these individuals.

**Forecasting Procedures**

An accurate method of forecasting must be established for an episodic control program to be effective. Meteorological teams from the National Weather Service (NWS), state environmental agencies, and local air pollution control agencies must evaluate historical meteorological and ambient air quality data to determine what meteorological conditions are associated with high pollutant concentrations. In most areas, programs rely on a team of meteorologists working together to determine which conditions are associated with episodic days and to predict when those conditions will occur. While it is difficult to measure the accuracy and precision of a forecasting system (see discussion below), several basic requirements are needed to ensure a minimal level of performance for a forecasting system.

- Completion of a forecasting protocol,
- Use of at least two years of ambient data to validate forecasting techniques
- Periodic validation of the methodology to assess the impact of changing emission trends
Tracking effectiveness of notification procedures

While it is essential that forecasting be completed accurately both to avoid ‘crying wolf’ to the general public and to avoid pollutant exceedance days (esp. for areas trying to maintain air quality standards) an ongoing evaluation of the forecasting system could be complicated by overall impacts of the episodic control program. Most areas have tested their predictive techniques for at least one season before disseminating the information to the public. Both false positive (Alert called/no exceedance measured) and false negative (No Alert called/exceedance occurs) predictions can occur. If the episodic program is very effective, false positives could occur if significant emission reductions result from the program’s control measures. False negatives could occur if certain activities resulting in higher than normal emission levels (e.g., special events such as the Olympics) occur. Most programs, especially those in attainment areas, would rather err in the positive direction than the negative direction. Thus, as a result, many areas will issue alert day notices which result in pollutant concentrations at levels below the standard. Depending upon the criteria set by the agency implementing the program, measures used to examine the effectiveness of the forecasting procedures should conform to the goals set by the implementing agency or coalition.

Program Evaluation

The inclusion of a feedback mechanism is necessary for maintaining an effective program. Surveys of CAPs indicate that there is wide variation in the types of program impacts that CAPs are interested in evaluating. Even though two areas may both have similar programs and goals (e.g., both CAPs focus on reduction of vehicle miles traveled), the amount of data that each area currently collects regarding the impacts of these programs may be significantly different. These differences can be attributed to factors such as budgetary and staff constraints, significance of the program in overall regional air quality planning, and degree of program participation. With these resource limitations in mind, areas interested only in maintaining a legitimate program (with federal oversight) should focus their limited resources on:

- Annual review of all program components
- Annual survey of public outreach components, and
- Submit a program report/review to oversight agency annually

CAPs that expect the program to contribute to achieving air quality improvement goals will generally be more concerned with the specific impacts of the program on daily emissions levels and air pollutant concentrations. These programs should try to determine changes in behavior associated with implementation of the program and calculate emissions using assumptions that are consistent with other parts of the State Implementation Plan (SIP) demonstration.

Tracking Overall Program Impacts

Determining Changes in Behavior

Because seasonal/episodic programs are voluntary, with no mandatory requirements for individual behavioral changes, no other techniques exist besides market research/survey techniques to assess behavioral changes. Some areas have attempted to use proxy data, such
as parking lot counts, to gain some level of insight into program effectiveness. These efforts have been largely unsuccessful. To quantify changes in behavior and corresponding emission reduction surveys should be completed on specific seasonal/episodic days to ensure that the data are accurate and that respondents' memories do not influence the results of the study. Questions should be worded and ordered to eliminate any bias as to the “preferred answer.”

An example set of behavioral survey questions are included in Appendix F. Example questions are included for collecting data on travel-related behavior changes as well as changes in household-related activities which produce emissions (e.g., use of gas-powered garden equipment, aerosol sprays, and painting). The survey questions included are the best identified from a review of the surveys being used by CAPs around the nation. Programs should not use the survey as is, but rather as a basis for developing an instrument tailored to their data collection needs. To assist in this customization, the survey in Appendix F is designed in a modular format so that CAPs can pick and choose the appropriate questions that match control measures suggested by their outreach efforts. The survey includes sections on changes in travel related behavior and has a section with broadly-worded questions that can be modified to capture changes in area source activities (e.g., lawn equipment, consumer products, painting). The last section of the survey contains questions on program awareness. These questions have been included so that the agency can determine if people are changing their behavior in response to the program’s outreach efforts.

As areas modify the survey to fit their particular needs, it’s important to remember a few key facets of survey design.

- Identification of survey objectives
- Determination of the survey mechanism
- Specification of the sample size and determination of participants
- Development of survey
- Survey implementation, data coding/error checking
- Examination and interpretation of results
- Development of follow-up actions

All of these are important elements; no steps should be skipped due to limited resources. Identification of specific objectives must be completed so that the appropriate survey mechanism and questions are correctly chosen. Since behavioral surveys need to be completed on episode days, use of phone surveys, which typically have quick turnaround times and high response rates, are most appropriate. Established industry standards regarding sample size\(^3\) and question/response wording should be followed to ensure that accurate and meaningful findings can be made from the data collected. Finally, the results of the survey should be examined and program changes/improvements, additional surveys, or recommendations for further studies should come out of the survey findings.

It is important to note that survey results and trends analyses must be viewed with a critical eye and repeated on an annual basis. As mentioned previously, data collected using market research tools can vary with factors not associated with the seasonal/episodic control program, such as changes in sample populations. In addition, over time, most public education programs are designed to expand the application of the program to a larger percentage of the population and instill some long-term behavioral changes. Both of these components will affect behavioral changes. Therefore changes in public behavior should be

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\(^3\) Sample sizes should be set so that subgroups contain at least 100 respondents (using estimated response rates and estimated subpopulation percentages).
monitored, at a minimum, on a yearly basis during an episode day. To determine trends in
behavior changes throughout the season and differences due to factors such as
weekday/weekend, behavioral surveys should ideally be given during as many alert days as
possible.

It should also be noted that potentially important travel-related issues should be addressed in
any survey of travel behavior. Many surveys currently used by agencies do not ask whether a
vehicle left at home by the respondent on an alert day was used by someone else in the
household during that time, nor do they ask whether people drove their car to a park-and-ride
lot to catch a carpool or transit. If either of these situations occur, then any resultant
emissions benefit may be lessened or may not be realized at all. Suggested additional
questions to identify these respondents, which will improve any travel and emissions estimates made
from the survey data, have been included in the survey in Appendix F. Not including them could
cause overestimation of the travel and emission reductions attributed to the program, although it is
unclear by how much. To further refine these estimates, CAPs might consider corroborating the
survey results with data on other potential measures of program effectiveness, such as transit ridership
levels, traffic counts, parking lot counts, HOV lane use, car/vanpool participation, and ambient air
quality measurements.

**Survey data on changes in emission-producing behaviors are combined with area-specific assumptions for key emission variables to generate estimates of emission reductions due to the program.**

**Determining changes in Emissions**

Using survey data collected on pollution episode days, agencies can estimated the reductions
in mobile source emissions attributable to their alert day programs. If collected using valid
data collection techniques, these data should indicate a level of awareness, willingness to
participate, and self-reported changes in public behavior. When these data are combined with
area-specific assumptions for key emission variables, a CAP could generate an estimate of
reduced emissions. In Sacramento, for example, estimates of the number of people that have
reduced driving on Spare the Air days have been obtained from survey results. Respondents
were asked how many round trips they reduced by postponing trips or taking an alternative
mode of transportation. From these data, the percentage of drivers in the survey that reduced
trips and the number of trips reduced per driver were determined. Coupled with vehicle
registration statistics and average trip length information, estimates of the number of total
trips and VMT reduced in the Sacramento region were extrapolated and combined with
emission factor data to estimate emissions reduced.

In any evaluation, the quality of the data collected directly influences the quality of the estimates made using the data. CAPs interested in estimating emissions impacts, especially those that have spent considerable resources gathering extensive behavioral change data, should also ensure that the appropriate emission assumptions (vehicle type, speed, roadway

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4 Another consideration might be the potential for increased emissions resulting from system-wide speed increases brought on by reduced traffic congestion. For instance, ozone nonattainment areas with large amounts of NOx emissions may see increases along corridors with extensive heavy-duty truck travel if speeds along that corridor increase. Areas should probably consider which types of trips (local, commuter - highway) would be reduced to improve accuracy of emission estimates.
type, temperature, etc) are used in the calculations. For obvious reasons, the emission estimates will be sensitive to the emission rates chosen for the evaluation. An area that uses a composite emission factor for one average temperature and speed to estimate the impacts of reducing work travel can be overlooking several key factors. For instance, light-duty autos and trucks are the primary vehicles used for work trips. A composite emission factor that includes the entire vehicle fleet could be overestimating the impacts of the program by including higher-emitting vehicle classes in the emission rate. Also, hourly temperature variation may significantly influence the rate at which emissions are produced. If a control program targets work trips in the AM and PM peak travel periods, it may be more accurate to calculate emission factors that are representative of the average temperatures occurring during these particular periods of the day. Finally, emission rates can vary significantly by speed, and using a single average speed for emission factor calculations could be responsible for emission impact estimates that are either too high or too low. CAPs should try to determine if the trips/VMT reduced are associated with short, local trip (trip-linking or delaying) or longer, higher speed commuter trips (telecommuting).

An example of an emission calculation is included in Appendix G. The general methodology used in the example is based on data collected from an episode day behavioral survey which asked people whether they actually reduced emission-related activities on alert days (beyond that which they typically participate in). The behavioral study should gather information on changes in driving behavior and associated emissions (i.e., how many round trips and how much VMT was reduced by postponing trips or taking an alternative mode of transportation). From this, the percentage of drivers in the survey that reduced trips and the number of trips reduced per driver was determined. Combining these data with vehicle registration statistics, and average trip length data, estimates of the number of total trips and VMT reduced in the region (needed to estimate emission factors) produce emission estimates. To obtain the registration, trip length, and emission factor data needed to complete the emissions estimates, agencies should contact the local MPO or state air quality planning agency to ensure that assumptions match those used in the local SIP. The procedure used to calculate the daily reductions in mobile source emissions from an alert day is shown in Figure 6-5.

![Diagram showing the procedure for calculating mobile source emissions reductions](image)

**Figure 6-5** Procedure for calculating mobile source emissions reductions

As discussed earlier, reduction in emissions associated with purely episodic behavior changes should only be applied in episode-specific modeling applications. However, seasonal or long-term emission reductions of emission estimates could be applied to seasonal emission inventories. In contrast to episodic behavioral changes, long-term and seasonal behavior changes can be used to estimate permanent changes in regional emission levels. Long-term behavioral changes are associated with permanent changes in individual or stationary source activities. Episodic changes, in contrast, are often associated with delaying activities (such as putting off mowing the lawn). Many of these activities, and their associated emission levels,
will eventually occur in the air basin. Therefore the emission reductions associated with these activities should be treated appropriately.

Procedures for Indirect Measures of Program Effectiveness

It is difficult to attribute changes in trends data, such as ridership, ambient air quality levels, or public health (e.g., emergency room visits) to the operation of a seasonal/episodic control program since many factors affect these data. Nonetheless, these data are still valuable to track since they can provide supporting evidence of the effectiveness or ineffectiveness of a program. The systematic collection of data - regularly and uniformly - will improve the quality of evaluation efforts. In addition, there is also a high likelihood that continuing efforts to collect and evaluate these data will increase their value as evaluation tools and techniques improve.

Regional Travel Indicators

Transit Data

Areas such as Cincinnati, Sacramento and Dallas have examined regional transit data to determine overall program impacts. Analysis of the bus data by the Cleaner Air Partnership of Sacramento showed that overall ridership levels did not increase on Spare the Air days compared to regular days. The analysis did show, however, that on Spare the Air days a greater percentage of riders paid with cash (as opposed to using a monthly pass) than normally. The Sacramento analysts think this may be an indication that more people who normally drive are using buses on Spare the Air days. This CAP is making efforts to obtain daily transit data for a more detailed analysis of this data.

The Cincinnati area has been examining transit ridership data to estimate seasonal emission reductions associated with their program. The Southwest Ohio Regional Transit Authority (SORTA) provided bus service at a reduced (CMAQ subsidized) fare for the summers of 1994, 1995\(^5\) and 1996. SORTA tracked increases in ridership over the budgeted ridership estimates\(^6\) to determine if the Smog Alert program had any impact on transit ridership. The difference between these two figures was assumed to be reduced trips with corresponding emission reductions. Since SORTA tracked costs associated with the reduced fares, they could also estimate the cost-effectiveness of the program.

In 1996, the fare reduction program, marketed as the “Clearance Sale” was in effect every weekday\(^7\) from June 1 through Labor Day. Examination of ridership data by SORTA indicated that because of the program, during that three month period Cincinnati experienced:

- 533,000 increased transit rides
- 2.6 million fewer vehicle miles traveled (VMT)
- 8.8 fewer tons of hydrocarbons (HC)
- 48 fewer tons of carbon monoxide (CO), and
- 5.7 fewer tons of nitrous oxides (NO\(_x\))

\(^5\) Low fares were restricted to alert days in 1995.
\(^6\) No data was provided by SORTA on assumptions that they used to estimate budgeted ridership.
\(^7\) Fares are already reduced to $0.50 on weekends.
Figure 6-6 shows the change in ridership recorded in 1996. The lower line indicates the budgeted ridership projections made by SORTA and the upper line is the actual recorded ridership during the summer of 1996. SORTA’s costs for operating this program were: $580,000 in lost revenue and $45,000 in marketing and promotion costs. Table 6-3 summarizes SORTA’s analysis of the overall impact of the program in 1996. The cost-effectiveness estimates for the program were similar to those measured in 1994. The cost-effectiveness of reducing one ton of CO was estimated at $13,020. Costs for reducing HC and NO\textsubscript{x} were $71,023 and $109,649 respectively.

![Graph showing ridership data](image)

Figure 6-6. Budgeted (lower line) verses actual (upper line) transit ridership due to the Cincinnati transit fare reduction program on pollution episode days (1996).

<table>
<thead>
<tr>
<th>Ridership</th>
<th>VMT</th>
<th>HC (tons)</th>
<th>CO (tons)</th>
<th>NO\textsubscript{x} (tons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Change</td>
<td>533,000</td>
<td>2,600,000</td>
<td>8.8</td>
<td>48</td>
</tr>
<tr>
<td>$/per</td>
<td>1.17</td>
<td>0.24</td>
<td>71,023</td>
<td>13,021</td>
</tr>
</tbody>
</table>

**Table 6-3. Smog alert program impacts on transit ridership, 1996.**

**Traffic Count Data**

State highway traffic count data has been obtained from the California Department of Transportation. A comparison of the 1995 data on normal days and on Spare the Air days by SMAQMD revealed that there were no noticeable changes in the traffic flow on freeways on Spare the Air days. SMAQMD indicated that there is a fairly high degree of natural variation in the freeway traffic flow and that any reductions in flow caused by the Spare the Air program are not great enough to be observed. Variation in flow might be controlled in a future study if enough resources were made available to analyze several years of traffic flow data. SMAQMD analysts report, however, that even if traffic flow changes were observed it would be difficult to attribute any of these to the Spare the Air program because of the large number of other variables which could be causing the changes. CAP analysis reported that they are not surprised that no changes are observed in freeway travel since the survey data show that few of the trips that are reduced on Spare the Air days are freeway trips. A more revealing study might be to look at traffic count data on local streets to see if there are any
observed changes in flows. SMAQMD has considered looking at local street traffic flows but is discouraged by the amount of resources it would take to analyze the large amounts of data.

Parking Count Data

A preliminary analysis of the number of receipts and total revenues from public parking lots in Sacramento did not show any significant changes on Spare the Air days. As with the traffic count data, SMAQMD reports that there is too much natural variability in the data to see any impact caused by the Spare the Air program.

Regional Air Quality Data

Few areas have tried to demonstrate program impacts using ambient air quality data. Examination of air quality trends is closely tied to examination of the accuracy of the forecasting procedures. Thus an agency could evaluate their program’s effectiveness using the following logic: if a high ozone day is predicted and an alert day is called but an exceedance does not occur, then the program is a success. No control experiments have been done (i.e., forecast the day and don’t call it) to evaluate this technique. Areas could also try to do a comprehensive analysis of air quality data collected over a long period to be able to separate air quality trends associated from program implementation from other interferences (weather, other impacts to regional emissions (decreases in vehicle emissions) due to control measures included in the SIP). However, if a CAP were to examine good data from normal days and alert days with similar characteristics, they might be able to delineate some impacts from the program.

Public Health Trends

CAPs may – in partnership with their local Health Department – initiate a system to track hospital admissions and emergency room visits on or after announced ozone action days. Numerous studies have been conducted on the health effects of ground level ozone but these local studies may be better received by citizens and may provide additional support for the programs and add an additional measurement of program benefits. The following section highlights the results of EPA’s review of the scientific literature to support a revised ozone standard. Based on recent studies, the scientific review highlighted several health effects for which the previous ozone standard did not provide adequate protection.

Exposure to ambient ozone concentrations has been linked to increased hospital admissions for respiratory ailments, such as asthma. Studies conducted in the northeastern United States and Canada show that ozone air pollution is associated with 10-20 percent of all of the related hospital admissions. Repeated exposure to ozone can make people more susceptible to infection and lung inflammation, and can aggravate preexisting respiratory diseases, such as asthma. Long-term exposures can cause repeated inflammation of the lung, impairment of lung defense mechanisms, and irreversible changes in lung structure, which could lead to premature aging of the lungs and/or chronic respiratory illnesses such as emphysema and chronic bronchitis.

Children and the elderly are most at risk from exposure to ozone because of their respiratory system’s vulnerabilities. Further, children are often active outside, playing and exercising, during the summertime when ozone levels are at their highest. Summer camp studies in the eastern U.S. and southeastern Canada have reported significant reductions in lung function in children active outdoors. Adults who are outdoors and moderately active during the summer...
months, such as construction workers and other outdoor workers, are also among those most at risk. These individuals, as well as those with respiratory illnesses, such as asthma, can experience a reduction in lung function and increased respiratory symptoms, such as chest pain and cough, when exposed to relatively low ozone levels during periods of moderate exertion.

The scientific review also highlighted concerns associated with ozone effects on vegetation for which the previous ozone standard did not provide adequate protection. These include reduction in agricultural and commercial forest yields, reduced growth and decreased survivability of tree seedlings, interfering with the ability of plants to store and produce food, increased tree and plant susceptibility to disease, pests, and other environmental stresses, reducing the aesthetic beauty of vegetation in national parks, and potential long-term effects on forests and ecosystems.

The EPA’s new ambient air quality standard for ozone is designed to address these health effects. Implementation of the standards is expected to significantly reduce respiratory-related ailments and result in overall improvements in public health. Specific benefits from the new standards include:

- 1 million fewer incidents of significant decreases in children’s lung functions per year
- Hundreds of thousands of fewer incidences per year of moderate to severe respiratory symptoms in children, such as aggravated coughing and difficult or painful breathing
- Thousands fewer admissions to hospitals and emergency rooms for respiratory causes
- Reduced risks of childhood respiratory-related illnesses
- Reduced yield loss of major agricultural crops, such as soybeans and wheat, and commercial forests by almost $500,000,000.

For additional discussion of the effects of ozone and the benefits of the new standard, see the EPA’s “Health and Environmental Effects of Ground-Level Ozone” Fact Sheet in Appendix C.
7 MINIMAL STANDARDS OF PERFORMANCE

Many areas implementing CAPs are either interested in achieving SIP emission-reduction credits or simply EPA recognition for their program. Outside agencies responsible for overseeing air quality programs and setting national guidance will need to establish minimal standards of program performance in order to determine which programs deserve recognition and/or SIP credit. The performance standards established should provide clear guidance for areas that want to calculate emission benefits, but also be flexible enough to allow areas that are only interested in gaining legitimacy for their programs to meet minimal standards.

At a minimum, areas seeking recognition must have a program which includes all of the core elements required for a comprehensive, successful CAP: public outreach, notification, forecasting, and program evaluation. Areas seeking emissions credits must also have a methodology for monitoring, evaluating and reporting the resulting emissions effect of the program. While it is beyond the scope of this project to identify guidelines for making CAP emission reduction determinations for SIPs, this section does provide a summary of ideas on minimum standards of performance that EPA can use to evaluate CAPs. For information on EPA’s policy for granting SIP credit for voluntary mobile source emission reduction programs, refer to Appendix A.

Public Outreach

Successful public outreach efforts ensure that all of the members of the community (businesses, agencies, general public) are aware of the CAP and understand what actions they can take on pollution episode days. Unless the public has heard and understands how they contribute to local air pollution problems, it is unlikely that they will take steps to reduce or delay emission-producing activities. With this in mind, minimal efforts needed to support a solid outreach program include:

- Outreach (meetings, workshops) with business, media and community groups

- Development of a clear, consistent message, including:
  - Program name, identifiable symbol, slogan
  - Suggested actions to reduce air quality
  - Web site with air quality, health information
  - School educational materials
  - Business/employer materials
  - Media package

- Tracking (through annual surveys, focus groups) of public awareness and education

Notification

A CAP’s notification system provides the call-to-action that mobilizes a community to reduce pollution on days of poor air quality. Timely notification of mass media outlets (TV, radio, newspapers) and local business partners and organizations is essential in order to provide the
general public enough time to plan ahead and make behavior change. In order to accomplish this, minimal standards for notification should include:

- Use of a fax tree, or equally-effective mechanism, to notify business and media,
- Transmission of a consistent message (using symbols, colors, or words) to clearly indicate different levels of air quality,
- Routine\(^1\) transmission of air quality information to all participants

**Forecasting**

An accurate method of forecasting must be established for an episodic control program to be effective. While it is difficult to measure the accuracy and precision of a forecasting system, several basic requirements are needed to ensure a minimal level of performance:

- Completion of a forecasting protocol,
- Use of at least two years of ambient data to validate forecasting techniques
- Periodic validation of the methodology to assess the impact of changing emission trends

**Program Evaluation**

The inclusion of a feedback mechanism is necessary for maintaining an effective program. Annual evaluations provide important information on the effectiveness of the program, how the various elements are working together, and how it can be improved. Areas interested in SIP credit for their program can conduct a detailed evaluation to quantify the emissions impacts of the program. Many areas, however, are only interested only in maintaining a legitimate program (with federal oversight). These programs should focus their resources on the following:

- Annual review of all program components
- Annual survey of public outreach components, and
- Submit a program report/review to oversight agency annually

**Summary**

Studies of CAPs around the nation have documented the core elements that must be included in a CAP in order for it to be successful. This guidance document has discussed these elements and provided suggestions on how to incorporate them into a program. At the core of every successful CAP is four core elements: public outreach, notification, forecasting, and program evaluation. For each of these elements, areas should seek to meet the minimum standards of performance outlined above. These criteria can be used by program developers, administrators and agencies providing oversight to determine whether a program meets the minimum criteria for demonstrating legitimacy.
### Figure 7.1 Minimal Standards of Program Performance

#### Public Outreach
- Outreach (meetings, workshops) with business, media and community groups
- Development of a clear, consistent message, including:
  - Program name, identifiable symbol, slogan
  - Suggested actions to reduce air quality
  - Website with air quality, health information
  - School educational materials
  - Business/employer materials
  - Media package
- Tracking (through annual surveys, focus groups) levels of public awareness and education

#### Notification
- Use of a fax tree to notify business and media,
- Transmission of standard (symbol, color, or words), consistent messages related to different levels of air quality,
- Routine daily\(^2\) (or weekday only) transmission of air quality information to all participants.

#### Forecasting
- Completion of a forecasting protocol,
- Use of at least two years of ambient data to validate forecasting techniques
- Periodic evaluation of the methodology to assess the impact of changing emissions

#### Program Evaluation
- Annual qualitative review/examination of effectiveness all program components
- Annual survey of public outreach components
- Submission of program report/review to oversight agency

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1 Businesses or media will be more apt to respond quickly to notification if the procedures are routine (i.e. daily transmissions).
2 Businesses or media will be more apt to respond quickly to notification if the procedures are routine.
Appendix A

EPA MEMO:
GUIDANCE ON INCORPORATING VOLUNTARY MOBILE SOURCE EMISSION REDUCTION PROGRAMS IN STATE IMPLEMENTATION PLANS (SIPs)
MEMORANDUM


FROM: Richard D. Wilson, Acting Assistant Administrator for Air and Radiation

TO: EPA Regional Administrators, 1 - 10

Introduction

This memorandum provides guidance and sets forth the Environmental Protection Agency’s (EPA) policy and interpretation regarding the granting of explicit State Implementation Plan (SIP) credit for Voluntary Mobile Source Emission Reduction Programs (VMEPs) under section 110 of the Clean Air Act. Voluntary mobile source measures have the potential to contribute, in a cost-effective manner, emission reductions needed for progress toward attainment and maintenance of the National Ambient Air Quality Standards (NAAQS). EPA believes that SIP credit is appropriate for voluntary mobile source measures where we have confidence that the measures can achieve emission reductions. This memorandum announces EPA’s intent to grant emission reduction credits for VMEPs, the terms and conditions for establishing and implementing VMEPs, and the requirements for approvable VMEP SIP submittals.

The establishment of this policy pertains solely to voluntary mobile source programs and is not intended to establish precedent for other air emissions source categories. Guidance on emission reduction credits for voluntary activities for other source categories may be established through future guidance documents. This policy also does not change existing EPA policy on credits for mobile source measures in the context of emissions trading programs or Economic Incentives Programs.

Policy Summary

The Clean Air Act Amendments of 1990 increased the responsibility of States\(^1\) to

\(^1\)Throughout this document, the term “State” refers to any state or local government body or agency with the authority to submit SIPs to EPA for approval.

1
demonstrate progress toward attainment of the NAAQS. At the same time, air pollution control programs in the U.S. have had difficulty regulating the emission reduction potential of smaller or unconventional sources. EPA supports innovative methods in achieving air quality goals and wishes to promote the creation of viable voluntary mobile source air quality programs. The desire to recognize the emission reductions from these sources has led the Agency to develop policies to support an increasing variety of innovative approaches. EPA recognizes that emission reduction credit toward SIP air quality demonstrations can be a positive factor for gaining political and institutional support for program development and implementation. The demonstration of air quality benefits is also desirable for program assistance through EPA’s section 105 grants and is a requirement for project eligibility under the Department of Transportation’s Congestion Mitigation and Air Quality Improvement (CMAQ) program.

This memorandum is intended to clarify the basic framework for ensuring that VMEPs become eligible for SIP credit. Generally, a State would submit a SIP which 1) identifies and describes a VMEP; 2) contains projections of emission reductions attributable to the program, along with relevant technical support documentation; 3) commits to monitor, evaluate, and report the resulting emissions effect of the voluntary measure; and 4) commits to remedy in a timely manner any SIP credit shortfall if the VMEP program does not achieve projected emission reductions.

EPA anticipates that this policy will generate additional interest and resources toward VMEP development and data collection. EPA wishes to ensure that the potential benefits of VMEPs are properly quantified and that these benefits are sustained as successful components of the SIP. As experience and information regarding the effectiveness of VMEPs becomes available, EPA intends to provide further technical guidance and assistance to the States. As States and EPA gain more experience with VMEPs in quantifying emissions benefits, more precise information will be available in determining the effectiveness of a range of programs. The type of information that EPA expects to gain from evaluating VMEPs includes emissions benefits, public response and education, cost of implementation, secondary indicators/benefits, quantification methodologies, and data collection.

EPA hopes that the effect of this policy will be to generate sufficient information and programmatic experience to warrant a wider application of VMEPs for progress toward attainment under the new NAAQS policy framework. EPA believes that States should benefit from this policy by having a wider range of programmatic options to consider. This policy will ultimately support the creation of new, cost-effective air quality programs and market-based incentives.

**Background**

Historically, mobile source control strategies have focused primarily on reducing emissions per mile through vehicle and fuel technology improvements. Tremendous strides have been made resulting in new light-duty vehicle emission rates which are 70 to 90 percent less than for the 1970 model year. However, transportation emissions continue to be a significant cause of air pollution due to a doubling of vehicle miles traveled (VMT) from 1970 to 1990, and tripling since 1960. In some quickly developing urban areas, the more recent VMT growth rate is even more
dramatic. In San Diego, California, VMT tripled between 1970 and 1990. VMT in Las Vegas, Nevada, increased 160 percent from 1981 to 1991, and nearly doubled in Phoenix, Arizona, during the same time period.

The increasing cost of technological improvements to produce incrementally smaller reductions in grams per mile or grams per kilowatt hour emissions in the entire fleet of vehicles and engines, along with the time it takes for technological improvements to penetrate the existing fleets, suggests that supplemental or alternative approaches for reducing mobile source air pollution are necessary. Mobile source strategies which attempt to complement existing regulatory programs through voluntary, nonregulatory changes in local transportation sector activity levels or changes in in-use vehicle and engine fleet composition are being explored and developed.

A number of such voluntary mobile source and transportation programs have already been initiated at the State and local level in response to increasing interest by the public and business sectors in creating alternatives to traditional emission reduction strategies. Some examples include economic and market-based incentive programs, transportation control measures, trip reduction programs, growth management strategies, ozone action programs, and targeted public outreach. These programs attempt to gain additional emissions reductions beyond mandatory Clean Air Act programs by engaging the public to make changes in activities that will result in reducing mobile source emissions.

**Definitions**

The following definitions apply to VMEPs as described in this memorandum.

**Voluntary Measures:** Emission reduction programs that rely on voluntary actions of individuals or other parties for achieving emission reductions.

**Seasonal Measures:** Emission reduction programs that are in effect only during the season in which the area experiences high pollutant concentrations.

**Episodic Measures:** Activity-based mobile source programs that are implemented during identified periods of high pollutant concentrations, varying by meteorological conditions. These measures may or may not be continuous in nature depending on program design. The statutory authority for approval of episodic measures in SIPs applies only to activity-based mobile source emission reduction measures as explained below.

**Clean Air Act Authority**

EPA plans to use its authority under the Clean Air Act to allow SIP credit for new approaches to reducing mobile source emissions. This policy represents a flexible approach regarding the SIP requirements set forth in section 110, and economic incentive provisions in

\[ \text{2The requirements regarding emission reductions needed to achieve attainment of the NAAQS.} \]
section 182 and 108 of the Act. This policy responds to State and local government interest in gaining SIP credits and funding for VMEP programs which will count toward their State’s plan to make progress toward attainment and maintenance of the NAAQS and builds on EPA’s history of approving measures that rely to some degree on voluntary compliance, such as provision of mass transit. Recognizing that only a limited amount of implementation experience currently exists, and that information on VMEP effectiveness will be evaluated and reported as a result of this policy, EPA plans to re-evaluate this policy in the future.

Authority to approve of voluntary measures in SIP

EPA believes that it has authority under CAA section 110 to approve voluntary measures in a SIP for emission reduction credit. However, EPA believes that as part of its SIP submittal a State must commit to monitor, evaluate, and report the resulting emissions effect of the voluntary measure, whether the measure is implemented directly by the State or another party, and to remedy in a timely manner any credit shortfall.

In light of the increasing incremental cost associated with additional mobile source emission reductions, the lead time required for new technologies to penetrate fleets, and the increasing need to target mobile source use to realize reductions, where voluntary measures meet the requirements of this policy, EPA believes that it is appropriate and consistent with the Act to allow a limited percentage of the total emission reductions needed to satisfy any statutory requirement, as described below, to come from voluntary measures. In the event the voluntary measure does not achieve the projected emission reductions, the State, having previously committed in its SIP to remediying such shortfalls, will pursue appropriate follow-up actions in a timely fashion including, but not limited to: adjusting the voluntary measure, adopting a new measure, or revising the VMEP emission credits to reflect actual emission reductions, provided overall SIP commitments are met. EPA believes that voluntary mobile source measures, in conjunction with the enforceable commitment to monitor emission reductions achieved and rectify any shortfall, meet the SIP control measure requirements of the Act.

Establishment of a cap on SIP credits allowed for VMEPs

Under this policy, in light of the innovative nature of voluntary measures and EPA’s inexperience with quantifying their emission reductions, EPA is setting a limit on the amount of emission reductions allowed for VMEPs in a SIP. The limit is set at three percent (3%) of the total projected future year emissions reductions required to attain the appropriate NAAQS. However, the total amount of emissions reductions from voluntary measures shall also not exceed 3% of the statutory requirements of the CAA with respect to any SIP submittal to demonstrate progress toward, attainment of, or, maintenance of the NAAQS. EPA has analyzed a number of

\[3\] For example, an ozone area classified as severe needing reductions of 200 tpd of volatile organic compounds (VOC) and 100 tpd of oxides of nitrogen (NOx) from the projected year 2005 baseline inventory could rely on VMEPs for up to 3% of the required reductions from each pollutant, or 6 tpd of VOC and 3 tpd of NOx. The area could also use all or a portion of these same reductions for purposes of meeting interim rate-of-progress (ROP) milestones, but again the 3% limit would apply. Thus, if the area needed 25 tpd of creditable VOC reductions to meet the 1999 ROP target, no more than 0.75 tpd of the VOC reduction in the 1999 ROP plan could come from VMEPs.
voluntary mobile source programs which could be incorporated into a SIP. The emission reduction potential of these programs is generally a fraction of one ton per day. A three percent limit on emission reductions from VMEPs will allow areas to implement and claim SIP credit for a significant number of voluntary mobile source programs. This cap still provides a sufficient incentive for developing and implementing VMEPs, while setting a limit on the extent to which a SIP can rely on innovative programs with which we have had limited experience.

**Relationship to Economic Incentive Programs**

The 1990 Amendments statutorily required the Agency to develop Economic Incentive Program (EIP) rules. The EIP provides general SIP guidance for the adoption of incentive and other innovative programs. Some programs that depend on voluntary actions also require either State or local government authorization to implement the program. In these cases, which include certain transportation control measures such as congestion pricing programs, it may be more appropriate to use the EIP authority to incorporate the measure into the SIP. Further, where emissions reductions are expected to exceed the 3% limit, EPA would anticipate the State could use the EIP to incorporate measures. If a State wishes to have a VMEP approved under the EIP program rules, EPA is willing to work with the State to develop such a program.

**Approval of Voluntary Measures into the SIP - Key Criteria**

This section sets forth minimum criteria for approval of VMEPs into SIPs. These criteria require that the VMEP not interfere with other requirements of the Clean Air Act, be consistent with SIP attainment and Rate of Progress requirements, and that emission reductions be:

1. **Quantifiable** - VMEP emission reductions must be quantifiable. The level of uncertainty in achieving emission reductions must be quantified, and this uncertainty must be reflected in the projected emission reductions claimed by the VMEP. VMEPs must also contain procedures designed to both evaluate program implementation and to report program results as described in the section “Technical Support for VMEPs” of this guidance.

2. **Surplus** - The VMEP emission reductions may not be substituted for mandatory, required emission reductions. States may submit to EPA for approval any program that will result in emission reductions in addition to those already credited in a relevant attainment or maintenance plan, or used for purposes of SIP demonstrations such as conformity, rate of progress, or emission credit trading programs.

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*In accordance with the Act language (section 182 (g)(4)(A)), the EIP applies to “incentives and requirements to reduce vehicle emissions and vehicle miles traveled,” including TCM’s contained in section 108 of the Act. In addition, the EIP defines mobile sources to mean on-road (highway) vehicles (e.g., automobiles, trucks and motorcycles) and non-road vehicles (e.g., trains, airplanes, agricultural equipment, industrial equipment, construction vehicles, off-road motorcycles, and marine vessels). In certain cases, States are required to adopt EIP provisions into their State Implementation Plan (SIP). The EIP also serves as guidance for all other States that choose to adopt EIP provisions into their SIP as non-mandatory EIPs. In 1994, the Agency issued EIP rules and guidance (40 CFR part 51 subpart U), which outlined requirements for establishing these programs.*
3. Enforceable - A State’s obligations with respect to VMEPs must be enforceable at the State and Federal levels. Under this policy, the State is not responsible, necessarily, for implementing a program dependent on voluntary actions. However, the State is obligated to monitor, assess and report on the implementation of voluntary actions and the emission reductions achieved from the voluntary actions and to remedy in a timely manner emission reduction shortfalls should the voluntary measure not achieve projected emission reductions. As stated earlier, EPA anticipates that the State will take the steps it determines to be necessary to assure that the voluntary program is implemented and that emission reductions are achieved so that corrective SIP actions are not required. For example, the State may want to sign a Memorandum Of Understanding (MOU) with the VMEP sponsors.

Any uncertainty in the emission reductions projected to be achieved by the VMEP must be estimated and reflected in the emission reduction credits claimed in the SIP. As part of this submission, the State must commit to conducting program evaluations within an appropriate timeframe. The State must also report the resulting information to EPA within an appropriate timeframe in order to document whether the program is being carried out, and emission reductions are being achieved as described in the SIP submittal. Through the program evaluation provisions contained in this policy EPA anticipates that States will discover any potential emission reduction shortfall in a timely manner and appropriately account for such shortfall either by changing the program to address the shortfall, adopting a new measure, or revising the VMEP’s emission credits to reflect actual emission reductions achieved, provided overall SIP commitments are met.

4. Permanent - Emission reductions produced by the VMEP must continue at least for as long as the time period in which they are used by applicable SIP demonstrations. The VMEP need not continue forever to generate permanent emissions reductions, but must specify an appropriate period of implementation in the SIP. Voluntary actions in such a program, and the resulting emission reductions, can be discrete (temporary) or continuous, depending on the nature of the program. For example, an ozone action day program which takes effect over an ozone season, but calls for specific actions on days when exceedences of the ozone standard are likely (i.e., episodic measures) is considered a continuous program producing discrete (temporary) reductions, and therefore the reductions are SIP creditable.

5. Adequately Supported - As with all SIP creditable programs, VMEPs must demonstrate adequate personnel and program resources to implement the program.

Approval of Episodic Measures

EPA has concluded that episodic transportation control measures and other mobile source related market response measures may be approved for SIP credit under the Act. Prior to the 1990 amendments to the Act, EPA believed that section 123 of the Act, which bars the use of dispersion techniques in calculating emission limitations, might apply to all control measures, including transportation and mobile source market controls. However, new language was added
to the Act in the 1990 amendments that EPA believes indicates a clear congressional intent to allow and even require the incorporation of episodic transportation and mobile source market response programs in SIPs.

Several new requirements added to the Act in 1990 specifically require adoption of transportation control measures as listed in section 108(f)(l) of the Act under certain circumstances. See, for example, section 182(c)(5) - Transportation Controls and section 182(d)(1) - Vehicle Miles Traveled. Section 108(e) and (f) authorizes EPA to issue guidance on various types of transportation control measures available for selection in the control programs required under section 182. Section 108(f)(1)(B) identifies methods that contribute to reductions in mobile source related pollutants during periods in which a primary NAAQS will be exceeded. Episodic transportation and market response measures designed to operate during periods when ambient pollution levels are anticipated to exceed the NAAQS clearly fall within the scope of these types of programs that Congress has authorized areas to include in their section 182 transportation and vehicle miles traveled programs.

EPA therefore concludes that any implication that section 123 may have applied to transportation and mobile source market response programs under the Act as amended in 1977 has been clarified by the Act as more recently amended in 1990 by the addition of the specific authorization for adoption of any program identified in section 108(f) under the transportation control programs required under section 182.

Technical Support for VMEPs

A State may take credit in its SIP for VMEPs only if they are quantifiable. VMEPs which are thought to be directionally sound, but for which quantification is not possible cannot be granted credit. EPA believes that carefully designed and implemented VMEPs are quantifiable to the extent necessary to grant SIP credit.

All VMEP submittals must include documentation which clearly states how the sources from which the reductions are occurring, are currently, or will be addressed in the emissions inventory, ROP plan, and attainment or maintenance plan, as applicable. This documentation should include a description of the assumptions used in estimating and tracking emissions and emissions reductions from affected sources.

The following sections are intended to provide general guidance on the elements of emission reduction calculation and evaluation procedures that must be addressed in a VMEP SIP submittal.

Emission Reduction Calculation

To receive SIP credit for a VMEP, the SIP submittal must contain a good faith estimate of emission reductions, including technical support documentation for the conclusion that the
measure will produce the anticipated emission reductions. VMEP emission reduction calculations must account for and be adjusted to reflect uncertainties in the program. The calculations must be adjusted to account for two types of uncertainty:

compliance uncertainty - the extent to which the responsible party (a public or private entity) will fully implement the VMEP program, and

programmatic uncertainty - the extent to which voluntary responses actually occur and/or the inherent uncertainties of program design.

The State must adjust the VMEP calculation for compliance and programmatic uncertainty, based on program design elements, and on the predictive quality of the information, data, and analytic methodology used by the State to develop the projected emission reductions. The State must justify the appropriateness of the adjustments in its VMEP SIP submittal, usually as part of the technical support document.

The adjusted emission reduction estimate should be developed and justified by the State by taking into account various elements of the VMEP program design. These elements could include, but not be limited to: the voluntary mechanism upon which the program is based, such as public outreach or reduced fares; the variability in emission rates from affected mobile sources; the extent of uncertainty in the emissions quantification procedure; and the frequency and type of program evaluation, monitoring, record keeping and reporting.

Evaluation Reporting Procedures

States which use VMEPs in their SIP must describe how they plan to evaluate program implementation and report on program results in terms of actual emissions reductions. Program evaluation provisions for VMEPs must be accompanied by procedures designed to compare projected emission reductions with actual emissions reductions achieved. The timing of the evaluations must be specified in the VMEP SIP submittal. The States and program sponsors will benefit from accurate and complete evaluation reports. EPA expects that program evaluations and experience gained over time will result in VMEP modifications to increase effectiveness.

The State must provide timely post-evaluation reports to the EPA relevant to the SIP time-frame in which the emission reductions are being used. These reports may be used by EPA for the purpose of reviewing subsequent SIP submissions required by the CAA, including but not limited to: periodic inventories, rate of progress (milestone compliance demonstrations), attainment demonstrations, and maintenance demonstrations.

EPA is working with State and local government representatives to develop methodologies which would provide sufficient technical support for VMEP SIP submissions. As results become available, EPA will provide technical guidance to assist in the development of VMEP emission reduction estimates and program evaluation procedures. However, EPA’s policy
is to recognize the experience of State and local voluntary programs in quantifying emission reductions and evaluating program results. Acceptable methodologies and procedures will not be limited to those developed by EPA, and programs are encouraged to discuss technically sound alternative methods with EPA Regional Office staff.

**VMEP Emission Reduction Use**

As explained above, under Title I of the Clean Air Act, EPA is permitting a limited amount of voluntary mobile source measures to be included in SIPs and FIPs and to be adopted for any criteria pollutant in both nonattainment and attainment areas. VMEP emission reductions shall be limited in use as determined by existing applicable SIP policy including offsets, Rate of Progress, attainment demonstrations, baseline determinations, redesignation and maintenance demonstrations.

**Future Guidance and Regional Coordination**

It is incumbent upon EPA Regional Offices and Headquarters to coordinate the implementation of this policy through consultation and exchange of information. It will be necessary to determine the appropriateness of individual VMEPs, applicability of emission reductions, development of methodologies to estimate emission reductions (including the appropriateness of uncertainty adjustments), peer review, and standardization of policy. To the extent that issues cannot be resolved through ongoing coordination efforts between Regional and Headquarters offices, issues may be ultimately raised through the SIP consistency process. EPA encourages early consultation between project sponsors, planners, and EPA’s Regional offices during the development of VMEPs.

For further information on EPA’s policy on VMEPs or the guidance set forth in this memorandum, contact Michael Ball of the Office of Mobile Sources, at 313-741-7897.

Attachments
Examples of Voluntary Mobile Source
Emission Reduction Programs

The following are some examples which are representative of voluntary mobile source emission reduction programs (VMEPs) that could be implemented and credited with emission reductions for SIP related purposes. These programs can and have been designed to be implemented on an episodic, seasonal, or a continual basis. More program examples and ideas may be found on the following websites:

EPA Office of Mobile Source Smart Travel Resources Center web site
(www.epa.gov/omswww/strc.htm)
Market Incentive Resource Center (www.epa.gov/omswww/market.htm)
Episodic Measures Database (www.epa.gov/omswww/reports/episodic/study.htm)

Employer Based Transportation Management Programs
Various programs implemented by employers to manage the commute and travel behavior of employees, such as: van pooling, car pooling, subscription buses, walking, shuttle services, guaranteed rides home, alternative work schedules, financial incentives(transit passes and subsidies) and on-site TDM support.

Work Schedule Changes
Changes in work schedules to provide flexibility to employees to commute outside of peak travel periods, such as: telecommuting, flextime, compressed work weeks, staggered work hours.

Area-wide Rideshare Incentives
Promotional assistance aimed at encouraging commuters to use alternatives to single occupant vehicles, such as: marketing of ridesharing services, transit station shuttles, computerized carpool matching, vanpool matching, program implementation assistance.

Parking Management
Management of parking supply and demand, such as: preferential parking locations for carpools and vanpools, preferential parking prices for carpools and vanpools, fee structures that discourage commuter parking, reduced parking for new developments.

Special Event Travel Demand Management
Special plans to manage travel demand in effect during special events, defined as
destinations for a large number of vehicle trips which occur on a one-time, infrequent, or scheduled basis (such as athletic events, festivals, and major entertainment performances). These measures could include parking management, remote parking connecting with transit or shuttle services, efficient traffic routing efforts, public information and communications systems.

**Vehicle Use Limitations/Restrictions**

Techniques to limit vehicle activity in a given geographic area or specified time period, such as: auto restricted zones, pedestrian malls, traffic calming, no-drive days, commercial truck restrictions on parking and idling.

**Reduced Vehicle Idling**

Measures to reduce the amount of time which vehicles spend in idle modes as part of their overall operation, such as: reduced operations of drive-thru facilities such as banks and fast-food restaurants, reduced construction of drive-thru facilities, programs that facilitate reducing idling at truck stops, transfer facilities and loading docks at commercial developments.

**Small Engine and Recreational Vehicle Programs**

Measures targeted at reducing the frequency and duration of small engine and recreational vehicle use. Other programs aim to shift the time period in which emissions producing activities, such as lawn and landscape maintenance, take place so that the negative impact on air quality is reduced. These measures are usually associated with episodic or seasonal control programs with a significant component of public education and outreach to encourage the voluntary change in activities.
Attachment 2

Example of a Voluntary Program

Program scenario: A State air quality agency is approached by a public utility to begin a lawn mower buy back program. The State would like to take credit for the emissions reductions from this private sector activity in its 15% plan.

Up-front credit: The State would like to take credit predicting the effect of the program in reducing emissions associated with replacing uncontrolled lawnmower emissions with electric — non polluting lawnmowers.

SIP Submittal

General Process
- State notifies EPA of its intent to take credit for voluntary lawnmower program. Includes program information and technical support documentation and commitment to remedy any emission reduction shortfall in a timely manner.
- Regional Office reviews and approves up-front credit after comments.
- Activity is conducted by the public utility.
- State verifies that the program achieved the predicted benefits and generates information for EPA review.
- Regional Office reviews the State SIP submission and determines that the credits have been achieved as predicted. Also approved under milestone compliance.

Program Identification: State submits to EPA its intent to conduct or take credit for the voluntary lawn mower buy back program in the SIP. The State will describe how the program or activity will work in practice. In the submission, the State will describe the following program elements.

Program participants
How the program works
Activity effects
Emission effects
State commitment for evaluation, reporting, remedying emission credit shortfall
Technical support documentation

Program Participants The State will identify the sponsors of the program. In this case the public utility.

How the Program Works As part of the submittal the State will include a description of the basic program, predicted effect of the program on a given NAAQS criteria pollutant and a
commitment to evaluate the program over the desired period of implementation and remedy any emission reduction shortfall in a timely manner.

In the submittal, the State describes the basic program including how the utility intends to facilitate the activity—buy back of lawn mowers. On three consecutive Saturdays, the utility customers and employees are able to bring in their gasoline powered lawnmowers and receive a voucher toward the purchase of any new electric lawnmower.

Activity Effects The State will submit predicted and observed activity effects. Data will be generated and analyzed which examines the predicted and actual effect of the program.

In this case, using information provided by the utility, the State estimates that 2000 lawnmowers would be replaced by non-polluting electric mowers.

Emission Effects Activity effects ultimately are translated into emissions benefit calculations (usually in tons per day/ per year).

The State would be given up-front credit for emission reductions in terms of HC, CO and other NAAQS criteria pollutants for 2000 mowers being replaced by electric mowers.

State Commitment for Evaluation, Reporting, and Addressing Credit Shortfall The State will be responsible for ensuring that data will be collected regarding participation and the effectiveness of the program. In addition, the State must commit to remedy any SIP credit shortfall in a timely manner if the voluntary measure does not achieve projected emission reductions.

The State, as part of the evaluation and reporting commitment, submits to EPA a comparison of the predicted effect of the program with the actual observed levels. In this example the utility finds that 2000 mowers were replaced. Thus, the predicted reductions were achieved.

Technical Support Documentation The State will submit Technical Support Documents describing the program and the methodology for predicting emissions benefits. Where possible the State should identify data collection methodologies and information necessary for describing implementation, compliance, effectiveness and other relevant information. This information should account for the following:

Programmatic Uncertainty - Because the program will be voluntary in nature, the State will be responsible for submitting to EPA the predicted and, eventually, the actual participation levels.

Analytic Methodology - The State will describe how they estimated participation levels and the effect of the activity on emissions
Appendix B

SAMPLE LETTERS TO COMMUNITY BUSINESSES
March 30, 1995

CEO
company name
address
city, state, zip

Dear CEO,

The greater metropolitan Chicago and northwestern Indiana region has a serious problem with summertime ozone air pollution, the main component of what is commonly termed "smog." Ozone is a significant health threat to us all and is especially threatening to children, the elderly, people who exercise, and those with respiratory and heart conditions. Because of these health concerns, ozone is a regulated pollutant. As such, ozone also poses a threat to further economic development in our region.

Partners for Clean Air is a recently formed voluntary coalition of regional businesses, health and environmental organizations, and local governments committed to cleaning our air. Our initial efforts are focused on voluntarily reducing ozone on summer Ozone Action Days when unhealthy levels are predicted, on average approximately 10-15 days a year. In joining Partners for Clean Air and implementing a simple strategy that works for you, (your company) can make a contribution to cleaner air when it is needed most. Participants are notified by fax the day before such an Ozone Action Day would occur.

We invite you to join Partners for Clean Air. Doing so is simple. First, identify and commit to one or more simple strategies that your company will voluntarily implement on Ozone Action Days. Enclosed are a sample of activities others have implemented. Second, sign and return the enclosed Partner's pledge—not a legal document but an indication of your voluntary commitment. The summer ozone season is closing in fast, so we would appreciate your response by (April 15). Call 1-800-xxx-xxxx in Illinois or (815)219-6060 in Indiana if you have any further questions or want more information on Partners for Clean Air or Ozone Action Days. A representative of the organization will call back to answer any questions you may have.

Thank you for your consideration.

The Partners
MEMORANDUM

Thursday, November 09, 1995

To: 2,000 area CEO's

Re: Your help with air quality and potential regulations

As you may know, the Richmond and Tri-Cities area has an air quality problem. If we violate the federal Clean Air Act again this summer or next, we will face tougher regulations which will cost businesses and individuals money and put serious restrictions on our ability to attract new jobs to our area. On days when harmful ground-level ozone exceeds the national health standard, some 86,000 people here suffer breathing difficulties or lung impairment. Your help to reduce pollution is critical.

An Ozone Advisory Program has been established to encourage voluntary conservation actions to reduce pollution on the two or three days each summer when we may exceed the Clean Air standard. The program is simple:

1) When the Department of Environmental Quality forecasts a high ozone pollution day for the next day (based on the weather), they issue an Ozone Advisory to the media and Ridefinders. 2) Ridefinders notifies participating employers, via simultaneous fax. 3) You notify your employees by the end of the day through a prearranged plan. 4) The media notifies the general public. 5) We all reduce polluting activities on the day of the Ozone Advisory by ridesharing and other practices, as in the enclosed brochures from Ridefinders.

We need your help. The cost is zero. All you do is: 1) Appoint a contact person (an Employee Transportation Coordinator), 2) Have him or her contact Ridefinders for help in setting up your participation plan. 3) Distribute instruction brochures to all your employees as soon as practical, and 4) Participate when an Advisory is called. The enclosed materials explain the program in more detail. You must act now, because we are in the ozone season and at risk of more regulations.

Join us and 80 other employers, with over 40,000 employees, who have already signed up to voluntarily clean up our air a few days each year rather than suffer the cost and inconvenience of year-round regulations. Other cities have done this successfully, so call Ridefinders today at 643-RIDE to help do it here. Thanks.

Metropolitan Richmond Chamber of Commerce  Retail Merchants Association  Ridefinders of Greater Richmond
July 15, 1996

FIELD(Name)
FIELD(Address)

Dear FIELD(Salutation),

On behalf of the Ozone Action program and its current participating organizations, I’d like to welcome you to the circle of Ozone Action Partners, and to thank you for your efforts.

You’ve joined an important program for our region, and an impressive coalition of concerned corporations, environmental groups and governmental agencies who are working to help improve air quality in a 14-county region. Through these efforts, we hope to reduce the number of times we exceed the national air quality health standards as measured through the daily amount of ground-level ozone present in our air this summer. As a result, we hope to see fewer exceedances during the crucial ozone season, which means less chance of increased emissions controls. Additionally, we hope to see some of the beneficial changes in routine continue throughout the rest of the year, helping to improve air quality and alleviate growing traffic congestion problems.

Enclosed in this folder are several key tools to help you spread the word to your employees and to other business contacts you deal with. Please take a moment to review all the components. If you have any questions, do not hesitate to contact our staff. Again, we appreciate your efforts and dedication, and will work with you every way we can to tackle and overcome this continuing problem.

Sincerely,

Executive Director

Enclosures
April 21, 1995

Dear Bay Area Employer,

Welcome to the 1995 *Spare the Air* program! Your organization's involvement in this campaign is an important part of the effort to keep the Bay Area's air clean and healthy. In this "How To *Spare the Air*" kit, you will find everything you need to launch a successful *Spare the Air* campaign, including:

1) A *Spare the Air* program calendar with important milestones and deadlines about the program;

2) Information on our *Spare the Air* kick-off breakfasts and workshop (please sign up by May 1);

3) Sample articles for your company newsletters;

4) Sample brochures that you can order from the Air District (free of charge);

5) An order form for free brochures, posters, videos and signs from the Air District (please return to Community Focus by June 1);

6) Sample signs for you to use in notifying your employees on *Spare the Air* days;

7) A list of our *Spare the Air* partners; and

8) Tips on motivating your employees.

If you have any questions about the *Spare the Air* program, please call Community Focus (the consultant helping to organize the employer program) at (415) 956-1811. If you have any questions about air quality or other Air District outreach programs, please call the Air District's Public Information Office at (415) 749-4900.

Again, thank you for helping to *Spare the Air*!

Best regards,

Air Pollution Control Officer
Bay Area Air Quality Management District
Appendix C

EXAMPLES OF OUTREACH MATERIAL
OZONE BACKGROUND

What is ozone?

Ozone is a gas and the main component of smog. Ozone is formed by the reaction of sunlight and carbon-based chemicals called "hydrocarbons" acting in combination with nitrogen oxides (Nox).

The "bad" ozone should not be confused with the protective layer of ozone in the upper atmosphere which protects the Earth from ultraviolet rays.

What do hydrocarbons come from?

Vehicle emissions create approximately 44% of all hydrocarbons. Industry sources like factories account for only about 20%.

Surprisingly, gas powered lawn equipment, oil-based paints and stain, dry cleaners, pleasure boating and other everyday sources account for about 36% of hydrocarbons. In general, the term hydrocarbon is interchangeable with volatile organic compounds (VOC).

Why is ozone bad?

Ozone can irritate mucous membranes and cause coughing, choking and impaired lung functions with prolonged exposure. Children, the elderly and people with bronchial conditions are apparently at risk. Ozone also injures vegetation and has adverse effects on materials (rubber and fabrics).

What contributes to the Cincinnati area's ozone problem?

Ozone is formed when pollution from cars, trucks, industry and other sources combines in sunlight. The sun "bakes" these pollutants, turning them into ozone, or smog.

-more-
About Ozone

The word "ozone" has prompted a lot of confusion and debate over the past few years. This confusion persists in part because ozone conjures both good and bad images and in fact both perceptions are correct. From a beneficial standpoint, we know that the ozone layer in the upper atmosphere is essential because it filters harmful ultraviolet radiation from the sun, reducing the amount reaching the earth's surface. On the other hand, high accumulations of ozone in the lower atmosphere near ground level can be harmful to people, animals, crops and other materials. The ozone gas in both the upper and lower atmosphere is the same; the difference is that one benefits and one harms.

The Ozone Layer

High in the stratosphere surrounding the earth, a layer of ozone gas forms an important and effective protective barrier against the sun's ultraviolet rays. News reports and articles in professional journals in recent years have documented a growing international concern, with many research studies suggesting that chemical pollutants are depleting this lifesaving ozone layer.

The most common ozone-destroying pollutants are in a class of chemical compounds known as fluorocarbons (CFCs). These compounds have had a diversity of human uses ranging from air conditioners to aerosol sprays. However, many of these products are being phased out, and manufacturers have developed substitutes that are much less damaging to the stratospheric ozone layer.

Unless we take action to protect the ozone layer, some scientists believe that an increase in ultraviolet radiation will cause a corresponding increase in human health hazards, such as the incidence of skin cancer and eye damage from exposure to sunlight. Studies have suggested plant life also could be seriously affected, even to the point of altering world food supplies.

Efforts to protect the stratospheric ozone layer now involve many different nations and industries. An agreement known as the Montreal Protocol was signed by many countries to help control production and use of CFCs. The Federal Clean Air Act amendments of 1990 also include the phase-out of ozone-depleting substances in this decade and the recycling of refrigerants from motor vehicle air conditioners, which began in 1992. The Texas Natural Resource Conservation Commission (TNRCC) is working with various industries and the public to see that recycling and other innovations help end the use of these pollutants.
What is ground-level ozone and where does it come from?

Ground-level ozone is the main ingredient in urban smog. In the presence of sunlight and heat, gaseous air pollutants react to produce ground-level ozone. These pollutants have many sources. Some are obvious, like automobiles, trucks, buses and industrial smoke stacks. Others are not, like gasoline stations, outboard motors, lawn, garden, farm, and construction equipment, oil-based paints and household products.

Is ozone hazardous to my health?

Yes. High concentrations of ground-level ozone can cause shortness of breath, coughing, wheezing, and pain with deep breaths. People who suffer from lung diseases like emphysema, bronchitis, pneumonia, asthma and colds have even more trouble breathing when the air is polluted. These effects can be worse in anyone who spends significant periods of time exercising or working outdoors on high ozone days.

What about children?

Children often play outside for long periods during the summer. Their lungs are still developing, and they breathe more rapidly and inhale more air pollution per pound of body weight than adults. On days when ozone smog levels are high, these factors put children at increased risk for respiratory problems.

What about exercising adults?

Adults take more than 10,000 breathes each day. During exercise or strenuous work, we breathe more often and draw air more deeply into the lungs. When we exercise heavily, we may increase our intake of air by as much as ten times. The interaction between air pollution and exercise is so strong that health scientists typically use exercising volunteers in their research.

Common Symptoms of Irritation From Ozone Pollution
GROUND-LEVEL OZONE

- Ground level ozone presents a significant air quality problem in the Baton Rouge area during the summer months. During 1990 through 1995, the Baton Rouge area experienced between 2 and 16 days each summer when federal air quality standards were violated.
- Ozone is a major element of urban smog. Ozone can lower resistance to diseases such as colds and pneumonia, damage lung tissue, intensify heart and lung disease, and cause coughing and throat irritation.
- Elevated levels of ozone can also harm vegetation, farm crops, and forests.

What is ozone?

Ozone is a colorless gas that can be found in the air we breathe. Each molecule of ozone is composed of three atoms of oxygen, one more than the oxygen molecule which we need to breathe to sustain life. The additional oxygen atom makes ozone extremely reactive. Ozone exists naturally in the earth's upper atmosphere, the stratosphere, where it shields the earth from the sun's ultraviolet rays. However, ozone found close to the earth's surface, called ground-level ozone, is considered an air pollutant.

How does ozone affect human health?

High concentrations of ozone may cause inflammation and irritation of the respiratory tract, particularly during heavy physical activity. The resulting symptoms may include coughing, throat irritation, and breathing difficulty. Inhaling ozone can affect lung function and worsen asthma attacks. Ozone may increase the susceptibility of the lungs to infections, allergens, and other air pollutants. Medical studies have shown that ozone damages lung tissue and that unhealthy effects may continue for days after exposure has ended.

Where does ground-level ozone come from?

Ozone is formed by a chemical reaction between volatile organic compounds (VOCs) and oxides of nitrogen (NOx) in the presence of sunlight. The primary sources of VOCs and NOx are automobile and industrial emissions. Other sources of VOCs include dry cleaners, bakeries, and consumer products such as paints, insecticides, and household cleaners. Ozone concentrations can reach unhealthy levels when the weather is hot and sunny with little or no wind. Elevated ozone levels usually occur between 1 p.m. and 7 p.m. from May through September.

How does ozone affect plant life?

There is clear evidence that ozone harms vegetation and forests. A 1988 study conducted by the EPA found that ozone pollution was reducing American crop yields by $3 billion each year. The study showed that in the hot summer of 1988, ozone reduced crop yields in experimental plots by as much as 30 percent. Ozone pollution also harms forests because it causes early leaf drop and lower growth rates.
Ozone is the same whether it is high altitude or ground-level.

However, it protects us high above the earth but can be bad for us to breathe near the ground.
TOP 10 TIPS

On Ozone Action Days, use this list and help reduce ozone (smog) formation.

1. Defer lawn and gardening chores that use gasoline-powered equipment.

2. Limit driving. Rideshare, carpool, walk or bike. Combine errands.

3. Take public transportation.

4. Postpone using oil-based paints and solvents.

5. Do not refuel on an Ozone Action Day. If you must refuel, do so after dusk.

6. Avoid excessive idling.

7. Keep your car well tuned.

8. Defer use of household consumer products that release fumes or evaporate easily.

9. Start charcoal with an electric or chimney-type fire starter instead of lighter fluid.

10. Conserve energy and recycle.

Stay informed.

For ozone information and to join the Clean Air Coalition call 220-2000 Access code 4AIR.

If you see a vehicle with excessive smoke coming from its exhaust, get the license number and call 1-800-453-SMOG.

The Texas Natural Resource Conservation Commission will notify the owner that his or her vehicle may be contributing to air pollution and provide them with information on how they can improve their vehicle's performance.
SMOG REDUCTION TIPS FOR BUSINESSES

Summer 1996

The Greater Cincinnati Chamber of Commerce has a comprehensive tipsheet of things that businesses can do to reduce ozone pollution especially on “Smog Alert Days,” including:

Transportation
- Encourage or provide incentives for employees to take the bus, car-pool, bike or walk to work.
- Plan meetings in the early morning, use conference calls, car-pool to meetings. Choose meeting locations that require the least total amount of driving.
- Consider telecommuting, four-day work weeks and flex-time so employees avoid driving during 3:00-6:00 p.m. rush-hour.
- Refuel fleet vehicles in the early morning or after 6:00 p.m. and don’t top off or spill fuel.

Facility issues
- Minimize bulk loading and unloading of fuel, solvents, and volatile chemicals; do this work in the early morning or after 6:00 p.m.
- Mow corporate lawns after 6:00 p.m.
- Use only water-based paints, cleaners, sealants, etc.
- Conserve electricity by turning the A/C warmer, deferring copying, turning out lights, turning off copiers and computers while not in use.

-more-
Do your share for cleaner air!

In order to increase public awareness when an ozone action day is called, the North Texas Clean Air Coalition is making available Ozone Action Day flags. On ozone action days, our goal is to have these bright yellow flags on the flagpoles of police and fire stations, libraries, city halls, post offices, schools and area businesses. With the November 1996 deadline approaching, it is crucial that we work together to remind the citizens of the Metroplex of the need to reduce emissions in order to maintain the economic viability of the region and to protect the health of us all. If your organization would like to assist in this effort, please complete the form below and fax or mail it to:

North Central Texas Council of Governments
P. O. Box 5888
Arlington, Texas 76005-5888
attn: Ozone Action Day Flags/Lynn Hayes

Fax: (817) 640-3028

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Ozone Action Day Flag Order Form

Flag description: 3' by 5' bright yellow nylon with black imprint of the Ozone Alert emblem and brass grommets.

Donation requested — $15.00 (please make checks payable to NTCAC)

Name of Company: __________________________________________________________

Contact person: __________________________________________________________

Address:_________________________________________________________________

City: __________________________ Zip: __________________________

Phone: ( ) __________________________ Fax: ( ) __________________________

Number of flags needed: ________

Would your company like to donate a flag to a local school, library, police or fire station?

( ) Yes ( ) No

If yes, have you identified a specific organization or location?

( ) No, provide it to a location of your choice on our behalf

( ) Yes, please send it to:

Name: _________________________________________________________________

Address: _______________________________________________________________

City: __________________________ Zip: __________________________

Phone: ( ) __________________________ Fax: ( ) __________________________
Welcome to the Ozone Action program! In order to make your efforts as easy as possible, we've included information and tools for you to use and distribute to your employees. Due to budget constraints, we ask for your cooperation in reproducing some of these materials.

1. TENT CARD: there are two of these included in your kit. They are designed to be placed at a reception desk or common point of entry to your site, to alert your employees about impending Ozone Action Days. If you cannot use them as standing cards, please punch a hole in the top, tape the bottom ends together inside (so the card is flat), and use them to hang on doors or by elevator banks. Additional cards are available at $1 each (see Order Form, included).

2. OZONE ACTION BROCHURE: we have included five of these, for your reference, and for distribution to appropriate employees directly involved with your OA effort. These can also be reproduced on a color copier, or, for best quality, greater quantities can be ordered (see Order Form).

3. EMPLOYEE FACT SHEET: this is designed as a general information vehicle for your employees, especially if you cannot order additional brochures. This can be reproduced on any copier.

4. EMPLOYEE ACTION RECORD: this is to allow your employees to record their actions on designated Ozone Action Days. While this is not mandatory for Business Partners, we ask for your cooperation in distributing and gathering these from your employees, to help us track efforts.

5. SHARE-A-RIDE BROCHURE: this explains the free service available to southeastern PA employers to have your employees matched to transit or in car and vanpools. NJ and DE employers can call the SAR number for information on similar services in their states. Please consider this opportunity for this summer, and the rest of the year.

6. ORDER FORM: this allows you to order additional materials, above, and to order OZONE ACTION FLAGS and T-SHIRTS. Please take a minute to review these options.

7. SAMPLE NEWSLETTER ARTICLE: this is meant to serve as a model to include in your internal and/or external communications. Please feel free to modify it as necessary, and to call DVRPC offices with any questions.

8. LOGO: A camera-ready logo and tagline have been included for use in publicizing the program. These can be cut and pasted or scanned for future use. If you wish to use color, the red behind the "O" in the logo is PMS 192.

9. CHILD'S WORK SHEET: this is designed to be distributed to employees to pass it on to important children in their lives. This allows many employees to keep an OA reminder in the home. This can also be used as a contest item to generate interest at your worksite.
OZONE ACTION PARTNERS:
DOING OUR SHARE FOR CLEANER AIR

Welcome to the Ozone Action program! By becoming a Business Partner, you join a group of committed Delaware Valley companies and organizations which are helping to make our first season a success. We'd like to know what activities your business plans to undertake as part of this effort, so please take a minute to fill out this form and return it as soon as possible.

Check the actions that your company or organization plan to take this Ozone season:

☐ Distribute program literature to employees.
☐ Announce OA Days at work (via signs, PA announcement, e-mail, etc.).
☐ Fax OA announcements to other offices and businesses, as part of fax notice "chain."
☐ Postpone refueling fleets and/or commercial mowing on OA Days.
☐ Voluntarily reduce other industrial emissions on OA Days.
☐ Sponsor employee or corporate contests to encourage OA awareness and participation.
☐ Offer employee transit or carpool incentives (see attached MAP information sheets).
☐ Include information about the program in company/customer newsletters and billing statements.
☐ Support public information and education campaign through editorial letters and columns, communications with government officials and other business peers.
☐ Serve as a resource or reference for news interviews, public meetings and speeches.
☐ Other: 

Beyond the call of duty

☐ Contribute funding for additional program educational or promotional materials or PSAs.
☐ Sponsor radio or television ozone forecasts and/or promotions.

COMPANY NAME: 

CONTACT NAME: 

PHONE #:  FAX#: 

Please send/fax your response to: Ozone Action Program
Delaware Valley Regional Planning Commission
111 S. Independence Mall East
Philadelphia, PA 19106
Phone: 215/592-1800      Fax: 215/592-9125
INTRODUCTION: WHAT IS THE OZONE ACTION! EDUCATION PACKET?

The West Michigan Clean Air Coalition's Ozone Action! Education Packet is designed to help students learn about ozone as a scientific and social issue and to teach them what they can do to improve our air quality. The packet is part of the Coalition's Ozone Action! Program, which monitors potential high ozone days (Ozone Action! Days) and encourages individuals and organizations to take actions that will reduce West Michigan's air pollution.

There are actually three packets, graded for different educational levels. This packet, for Grades 6-8, includes:

✓ Background Fact Sheet for Teachers
✓ Learning Activities for Students
✓ A List of Actions That Students (and Others) Can Take to Reduce Ozone
✓ A Glossary, Poster, and Suggestions for Additional Activities.

With this packet, students will learn about the makeup of the atmosphere, including the major gases and the problem of ozone pollution. The lessons will focus on the role of ozone (O₃) in the atmosphere and as a primary component of urban air pollution. Students will also learn how weather affects air pollution problems.

The packet is designed to be used alone as a drop-in unit or as a supplement to other curricula. Although the packet contains five learning activities, with associated supplementary materials, teachers are encouraged to adapt the material and activities for their individual needs.

For further information, additional materials, or other assistance, teachers can call the West Michigan Clean Air Coalition at 1-800-65-OZONE (656-0663) or at 616-776-3876.
Ozone Action! Program
Teacher Education Packet
Grades 6-8

Classroom Activities #1-5
& Ancillary Materials

Activity #1: Three Newspaper Articles (pp. 1-3.a)
Activity #2: Atmosphere Fact Sheet (p. 4)
Activity #3: Two pages and Six Data Sheets (pp. 5-11.a)
Activity #4: What is Your AQ?-Quiz & Answer Sheets (pp.12-13)
Activity #5: Community Survey Form & Ozone Action! Tips for Students (pp. 14-15)
Ozone Action! Tips Card
Ozone Action! Poster
Do Your Share For Cleaner Air Coloring Book.

How you can help on Ozone Action days and year-round.
It's an OZONE ACTION DAY, but Coach Ozone's hat is too tight, and he can't think straight. Can you help Coach Ozone decide what he ought to do? Below are some problems and possible answers. Check (+) the answer that you like best. Some problems have more than one good answer.

A. How should Coach Ozone get to work?
   + Drive with 2 or more friends.
   + Take the bus or subway.
   + Drive alone.
   + Skateboard.
   + Bicycle.

B. Coach Ozone has to drive to work so he can pick up the pizza on his way home (yum!). Which auto should Coach drive?
   + Old Beesy kind of smelly.
   + Old Beesy after a tune-up.
   + The new car (runs like a top).

C. Coach Ozone's auto is getting low on gas, but he is hungry for that pizza. Should he...
   + Fill it up now, during the cooler evening hours?
   + Wait til he goes out tomorrow afternoon (it's supposed to be about 95°)?

D. When Coach Ozone fills up the gas tank, should he get it as full as possible, even if it drips, or stop at the first click?
   + Stop earlier
   + Overflow it! You don't want to have to come back too soon, do you?

E. Coach Ozone's wife thinks the grass is way too tall, but Coach thinks that the gas lawnmower spills a lot of fumes.
   + Coach should get a tune-up on that gas mower, and then mow that evening.
   + Coach should mow in the afternoon, and work on his tan while he's at it!
   + Use that old manual push mower.

F. Coach wants to paint the TV room. What kind of paint should he use?
   + Latex (water-based).
   + Oil (solvent-based).
   + Oil (solvent-based), but wait til it's cooler.

G. Do you think that Coach and the other Ozone Action Partners should always live like this?
   + Yes.
   + It would be nice, but... get real!
   + No, just on OZONE ACTION DAYS.

COACH OZONE'S QUIZ

TEACHER RESOURCE
# EVALUATION

The Education Committee of the Southwest PA Ozone Action Partnership is very interested in your response to the "Know Your Ozone" Education Package. Please respond to the following questions, adding comments if you have them, and return completed form to:

Betsy Mallison  
Chairman, Communications Committee  
Southwest Ozone Action Partnership  
400 Waterfront Drive  
Pittsburgh, PA 15222-4745

<table>
<thead>
<tr>
<th>Item</th>
<th>++</th>
<th>+</th>
<th>?</th>
<th>-</th>
<th>--</th>
</tr>
</thead>
<tbody>
<tr>
<td>Did you have a clear understanding of ground-level and stratospheric ozone issues before reading this package?</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Did this package increase your understanding of ozone issues?</td>
<td></td>
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</tr>
<tr>
<td>Is the subject matter clear and easy to understand?</td>
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</tr>
<tr>
<td>Are the materials age-appropriate?</td>
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</tr>
<tr>
<td>Did you use any of the materials in your classroom this year?</td>
<td></td>
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</tr>
<tr>
<td>Will you use any of the materials in your classroom next year?</td>
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<tr>
<td>Which materials were your favorites? Why?</td>
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<tr>
<td>Which materials did you like the least? Why?</td>
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<tr>
<td>Any additional comments?</td>
<td></td>
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</tbody>
</table>
HEALTH AND ENVIRONMENTAL EFFECTS OF GROUND-LEVEL OZONE

Why are We Concerned about Ground-Level Ozone?

- Ozone is the prime ingredient of smog in our cities and other areas of the country. Though it occurs naturally in the stratosphere to provide a protective layer high above the earth, at ground-level it is the prime ingredient of smog.

- When inhaled, even at very low levels, ozone can:
  - cause acute respiratory problems;
  - aggravate asthma;
  - cause significant temporary decreases in lung capacity of 15 to over 20 percent in some healthy adults;
  - cause inflammation of lung tissue;
  - lead to hospital admissions and emergency room visits [10 to 20 percent of all summertime respiratory-related hospital visits in the northeastern U.S. are associated with ozone pollution]; and
  - impair the body's immune system defenses, making people more susceptible to respiratory illnesses, including bronchitis and pneumonia.

Who is Most at Risk from Exposure to Ground-Level Ozone?

- Children are most at risk from exposure to ozone:
  - The average adult breathes 13,000 liters of air per day. Children breathe even more air per pound of body weight than adults.
  - Because children's respiratory systems are still developing, they are more susceptible than adults to environmental threats.
  - Ground-level ozone is a summertime problem. Children are outside playing and exercising during the summer months at summer camps, playgrounds, neighborhood parks and in backyards.

- Asthmatics and Asthmatic Children:
  - Asthma is a growing threat to children and adults. Children make up 25 percent of the population and comprise 40 percent of the asthma cases.
  - Fourteen Americans die every day from asthma, a rate three times greater than just 20 years ago. African-Americans die at a rate six times that of Caucasians.
  - For asthmatics having an attack, the pathways of the lungs become so narrow that breathing becomes akin to sucking a thick milk shake through a straw.
- Ozone can aggravate asthma, causing more asthma attacks, increased use of medication, more medical treatment and more visits to hospital emergency clinics.

- **Healthy Adults:**
  - Even moderately exercising healthy adults can experience 15 to over 20 percent reductions in lung function from exposure to low levels of ozone over several hours.
  - Damage to lung tissue may be caused by repeated exposures to ozone -- something like repeated sunburns of the lungs -- and this could result in a reduced quality of life as people age. Results of animal studies indicate that repeated exposure to high levels of ozone for several months or more can produce permanent structural damage in the lungs.
  - Among those most at risk to ozone are people who are outdoors and moderately exercising during the summer months. This includes construction workers and other outdoor workers.

**How does Ground-Level Ozone Harm the Environment?**

- Ground-level ozone interferes with the ability of plants to produce and store food, so that growth, reproduction and overall plant health are compromised.

- By weakening sensitive vegetation, ozone makes plants more susceptible to disease, pests, and environmental stresses.

- Ground-level ozone has been shown to reduce agricultural yields for many economically important crops (e.g., soybeans, kidney beans, wheat, cotton).

- The effects of ground-level ozone on long-lived species such as trees are believed to add up over many years so that whole forests or ecosystems can be affected. For example, ozone can adversely impact ecological functions such as water movement, mineral nutrient cycling, and habitats for various animal and plant species.

- Ground-level ozone can kill or damage leaves so that they fall off the plants too soon or become spotted or brown. These effects can significantly decrease the natural beauty of an area, such as in national parks and recreation areas.

- One of the key components of ozone, nitrogen oxides, contributes to fish kills and algae blooms in sensitive waterways, such as the Chesapeake Bay.

**What Improvement Would Result from EPA’s New Standards?**

EPA’s new ozone standards will provide increased protection beyond that provided by the previous standard from the following effects:

- Reduced risk of significant decreases (15% to over 20%) in children’s lung functions (such as difficulty in breathing or shortness of breath), approximately 1 million fewer incidences each year, which can limit a healthy child’s activities or result in increased medication use, or medical treatment, for children with asthma.

- Reduced risk of moderate to severe respiratory symptoms in children, hundreds of thousands of fewer incidences each year of symptoms such as aggravated coughing and difficult or painful breathing.
• Reduced risk of hospital admissions and emergency room visits for respiratory causes, thousands fewer admissions and visits for individuals with asthma

• Reduced risks of more frequent childhood illnesses and more subtle effects such as repeated inflammation of the lung, impairment of the lung's natural defense mechanisms, increased susceptibility to respiratory infection, and irreversible changes in lung structure. Such risks can lead to chronic respiratory illnesses such as emphysema and chronic bronchitis later in life and/or premature aging of the lungs

• Reduce the yield loss of major agricultural crops, such as soybeans and wheat, and commercial forests by almost $500,000,000.

**Background: What is Ground-level Ozone?**

• Ozone is not emitted directly into the air, but is formed by gases called nitrogen oxides (NOx) and volatile organic compounds (VOCs) that in the presence of heat and sunlight react to form ozone. Ground-level ozone forms readily in the atmosphere, usually during hot weather.

• NOx is emitted from motor vehicles, power plants and other sources of combustion. VOCs are emitted from a variety of sources, including motor vehicles, chemical plants, refineries, factories, consumer and commercial products, and other industrial sources.

• Changing weather patterns contribute to yearly differences in ozone concentrations from city to city. Also, ozone and the pollutants that cause ozone can be carried to an area from pollution sources located hundreds of miles upwind.
Appendix D

EXAMPLES OF NOTIFICATION MATERIAL
ACTION GUIDES.

Several areas have developed ozone or air quality-related materials packaged as “action guides.” These educate the public about ozone alert levels and provide suggested actions that can/should be taken at the various levels. As noted in Chapter 5, ozone levels are commonly communicated by categories that are based on predicted or observed ozone concentrations. For instance, the Georgia Department of Environmental Protection uses the Red, Yellow, and Green color system to notify residents when there is an ozone Warning, Watch, or when the air quality is Good. Several other areas use four categories, although the precise definition and terminology varies from region to region. The following Table outlines these notification levels.

<table>
<thead>
<tr>
<th>Region</th>
<th>Category Names and Concentration Ranges (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baton Rouge</td>
<td>Unhealthful</td>
</tr>
<tr>
<td></td>
<td>Approaching Unhealthful</td>
</tr>
<tr>
<td></td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>89-99</td>
</tr>
<tr>
<td></td>
<td>51-88</td>
</tr>
<tr>
<td></td>
<td>0-50</td>
</tr>
<tr>
<td>Delaware Valley</td>
<td>Unhealthful</td>
</tr>
<tr>
<td></td>
<td>Approaching Unhealthful</td>
</tr>
<tr>
<td></td>
<td>125+</td>
</tr>
<tr>
<td></td>
<td>110-124</td>
</tr>
<tr>
<td></td>
<td>63-109</td>
</tr>
<tr>
<td></td>
<td>0-62</td>
</tr>
<tr>
<td>Maryland</td>
<td>Unhealthy</td>
</tr>
<tr>
<td></td>
<td>Approaching Unhealthy</td>
</tr>
<tr>
<td></td>
<td>125+</td>
</tr>
<tr>
<td></td>
<td>111-124</td>
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<tr>
<td></td>
<td>61-110</td>
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<tr>
<td></td>
<td>0-60</td>
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<tr>
<td></td>
<td>Code Red</td>
</tr>
<tr>
<td></td>
<td>Code Orange</td>
</tr>
<tr>
<td></td>
<td>Code Yellow</td>
</tr>
<tr>
<td></td>
<td>Code Green</td>
</tr>
</tbody>
</table>

The four basic categories and color schemes presented above can be used to categorize types of actions included in guides for specific regions. The following is an example.

**Good (Code Green)**

Throughout the ozone season, residents should make an extra effort to:

- Carpool, use transit, telecommute, bike or walk
- Use environmentally safe paints and cleaning products.
- Keep cars lawn equipment and boats tuned up.
- Keep gas tank full but don’t overfill
- Drive on radial tires that are properly inflated.
- Use electric or natural gas grills instead of charcoal and lighter fluid.
Moderate (Code Yellow)

When air quality is moderate and a Code Yellow is issued, residents are urged to:

- Conserve energy and set air conditioners to 78°
- Plan ahead to consolidate trips or errands.
- Plus those in Code Green

Approaching Unhealthful (Code Orange)

When air quality approaches or is forecast to reach unhealthful ozone levels and a Code Orange is issued, residents are urged to:

- Refuel after dusk to limit daytime pollution releases
- Avoid mowing lawns with gasoline-powered mowers
- Share a ride or drive alternative fuel vehicles or the newest best maintained vehicles.
- Plus those in Code Green and Code Yellow

Unhealthful (Code Red)

When air quality reaches or is forecast to reach unhealthful ozone levels, a Code Red is issued and sensitive populations are specifically alerted:

- Children and elderly individuals should reduce outdoor activities.
- Healthy individuals should limit strenuous outdoor work or exercise
- Individuals with heart or respiratory ailments, emphysema, asthma, or chronic bronchitis should limit their outdoor activities. If breathing becomes difficult move indoors.

All residents are strongly urged to:

- Limit idling when possible, avoid jack rabbit starts, and drive within the speed limits.
- Share a ride to work or work at home
- All Code Green, Yellow, and Orange actions
OZONE ACTION PROGRAM
BATON ROUGE CLEAN AIR COALITION

AIR QUALITY ACTION GUIDE

Air Quality
(Pollutant Standard Index (PSI) and Classification)

Weather Conditions

Recommended Actions

100 +
Unhealthful

- Hot (mid 90’s to 100’s) and hazy
- Stagnant air, little or no wind
- Little chance of rain
- Stationary high pressure system with sunny skies

A. When air quality reaches unhealthful levels:
- Children and elderly individuals should reduce outdoor activities.
- Healthy individuals should limit strenuous outdoor work or exercise.
- Individuals with heart or respiratory ailments, emphysema, asthma, or chronic bronchitis should limit their outdoor activities. If breathing becomes difficult, move indoors.

B. When air quality is forecast to reach unhealthful levels, residents are strongly urged to:
- Limit driving and, when possible, idling.
- Share a ride to work, or work at home.
(Plus items listed in C, D, and E)

89 - 99
Approaching Unhealthful

- Temperatures in the upper 80’s to low 90’s
- Light winds
- Slow-moving high pressure system with sunny skies

C. When air quality approaches unhealthful levels, residents are urged to:
- Refuel cars after dusk to limit daytime pollution releases.
- Avoid mowing lawns with gasoline-powered mowers.
- Share a ride or drive only their newest, best maintained vehicle.
(Plus items listed in D and E)

51 - 89
Moderate

- Mild summer temperatures (upper 70’s to mid 80’s)
- Light to moderate winds
- High pressure system with partly cloudy or sunny skies

D. When air quality is in the moderate range, residents should:
- Consolidate trips and errands.
- Conserve electricity and set air conditioners to 78°F.
(Plus items listed in E)

0 - 50
Good

- Cool summer temperatures (mid 70’s to low 80’s)
- Windy Conditions
- Rainfall
- Passing cold front

E. Throughout the ozone smog season (May through September), residents should make an extra effort to:
- Carpool, use transit, bike or walk when possible.
- Keep cars and boats tuned-up.
- Use environmentally safe paints and cleaning products.

Air Quality Information (504) 765-0905

Daily PSI Report (504) 295-8541
For more air quality information, call MDE's Air Quality Hotline at (410) 631-3247

Scroll down to see what you can do to help clean the air!

The Maryland Department of the Environment uses a color-coded scheme to forecast ground-level ozone levels in the Baltimore and Washington metropolitan areas. The color scheme used is listed below.

- **CODE GREEN**: good air quality—ozone levels to be less than 61 parts per billion (ppb)
- **CODE ORANGE**: approaching unhealthy —ozone levels to be between 111 and 124 ppb
- **CODE RED**: unhealthy air quality—ozone levels to be equal to or greater than 125 ppb

Throughout the ozone smog season (May through September) and when air quality is **CODE GREEN**, residents are urged to:

- Carpool, use transit, bike or walk when possible.
- Keep cars and boats tuned-up.
- Use environmentally safe paints and cleaning products.

When air quality is **moderate and a CODE ORANGE** is issued, residents are urged to:

- Consolidate trips and errands.
- Limit vehicle idling when possible.
- Conserve electricity and set air conditioners to 78 degrees Fahrenheit.

When air quality approaches or is forecasted for unhealthful ozone levels and a **CODE ORANGE** is issued, residents should:

- Refuel cars after dusk to limit daytime pollution releases.
- Avoid mowing lawns with gasoline-powered mowers.
- Share a ride or drive only the best maintained vehicle.

When air quality reaches or is forecasted for unhealthful ozone levels and a **CODE RED** is issued, residents are strongly urged to:
- Limit driving and, when possible, combine errands.
- Use area bus and rail lines, or share a ride to work.
- Avoid mowing lawns with gasoline-powered mowers.
- Refuel cars after dusk.

Also, the Maryland Department of the Environment reports air quality using the Pollutant Standard Index (PSI). The PSI converts measured pollution concentrations to a number on a scale of 0 to 500. Today's Pollution Standard Index can be found under Today's Weather in the *Baltimore Sun* and the *Washington Post*, or by calling the Air Quality Hotline at (410) 631-3247. A conversion of PSI to the Color Coded Forecast is found below.

### Pollutant Standard Index

<table>
<thead>
<tr>
<th>Pollutant Standard Index Reading (PSI)</th>
<th>Corresponding Color Coded Forecast</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-50</td>
<td>Code Green</td>
<td>Good Air Quality</td>
</tr>
<tr>
<td>51-100</td>
<td>Code Orange</td>
<td>Approaching Unhealthy Levels</td>
</tr>
<tr>
<td>101+</td>
<td>Code Red</td>
<td>Unhealthy Air Quality</td>
</tr>
</tbody>
</table>

For additional air quality information, check out:

- the Metropolitain Washington Council of Government's Air Quality Page
- the University of Maryland's Ozone Forecasting Page

Ground-level ozone pollution is a serious problem in urban areas such as the Baltimore and Washington regions. To find out more information on ground-level ozone visit the Ozone Information Page.
Bay Area Air Quality Forecasts

May 22, 1997

Employers: Register for electronic notification of Spare the Air days this summer!

<table>
<thead>
<tr>
<th>North Counties</th>
<th>Coast &amp; Central Bay</th>
<th>Eastern District</th>
<th>South Central Bay</th>
<th>Santa Clara Valley</th>
</tr>
</thead>
<tbody>
<tr>
<td>THU 42</td>
<td></td>
<td>42</td>
<td>42</td>
<td>42</td>
</tr>
<tr>
<td>FRI 42</td>
<td></td>
<td>42</td>
<td>42</td>
<td>42</td>
</tr>
</tbody>
</table>

Unless otherwise noted, the above referenced pollutant is ozone.

If a *Spare the Air* day is predicted this page will announce it by 1:30 PM. The actual numbers will be posted by 4:30 PM. This page is updated daily, except on those weekends when air quality is predicted to remain healthful and a three-day forecast is made.

- **NEW** Clean Air Champions Homepage
- What to do on a *Spare the Air* day
- The Pollutant Standards Index - What the numbers mean
- A day in the life of ozone
- Air quality forecasting - How it's done
- 1997 Box Scores - Ozone Excesses
- Comprehensive links to Bay Area transit and commute alternatives
- *Spare the Air* in Sacramento

This page is maintained by the *Bay Area Air Quality Management District*.

E-mail comments/questions regarding the Spare the Air website to wmtaylor@baaqmd.gov

13868
CURRENT AIR QUALITY READINGS

Central Delaware Valley: Burlington and Mercer Counties

This chart shows the highest reading in the region for each pollutant and the monitoring site at which the reading was recorded. The tallest bar determines the overall rating in the region. Values over 100 represent unhealthful levels.

Current data as of 11:00 am, May 23, 1997

- Unhealthful
- Approaching Unhealthful
- Moderate
- Good

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Carbon Monoxide</th>
<th>Nitrogen Dioxide</th>
<th>Ozone</th>
<th>Particulates</th>
<th>Sulfur Dioxide</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highest Site</td>
<td>Burlington</td>
<td>Rider U.</td>
<td>Rider U.</td>
<td>Burlington</td>
<td>Burlington</td>
</tr>
<tr>
<td>Number of Sites</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Central Delaware Valley sites:

Select one of the site names from the list below to get current readings for that site.

- Burlington
- Rider University
Ozone Action Partnership

Ground-Level Ozone Forecast

Yellow

Forecast for period
September 3, 1996

Forecast issued
September 2, 1996, 1420 EDT

Forecast range
CODE YELLOW

Forecast Discussion

Summer has finally arrived with only three weeks to spare. Expect warm conditions Tuesday with ozone in the upper moderate range.

Tuesday will be another fine summer day with conditions ripe for higher ozone. Temperatures will climb to the mid-upper 80's with light winds becoming southerly. The limits on ozone production will be low, late summer sun angle and a chance for upper level clouds to take the edge off both temperatures and sun.

LONG RANGE OUTLOOK:

The remainder of the week will be partly to mostly sunny and warm as the region basks on the western fringes of the Atlantic high. Ozone will remain in the upper moderate range with daily concentrations depending on cloud cover particularly clouds associated with the cutoff low over the southeast. By Friday, we will again have to closely monitor conditions as Fran follows the track of Edouard around the Atlantic high and then north along the coast.

*** For the latest hurricane information see:
http://www.neosoft.com/citylink/blake/tropical.html
http://www.nrlmry.navy.mil

Ryan

- CODE RED - UNHEALTHFUL
  125 ppb or more
- CODE ORANGE - APPROACHING UNHEALTHFUL
  110 to 124 ppb
- CODE YELLOW - MODERATE
  63 to 109 ppb
- CODE GREEN - GOOD
  62 ppb or less
Although the Ozone Action! season has begun, ozone levels are expected to remain low for the immediate future.

Ozone (ppb)
5/20/1997

Data Subject to Verification

Clicking on a site will show hourly measurements. To see modified maps showing the next hours data, be sure to refresh/reload the screen. Meteorological data is not collected at ALL sites. The buttons below display daily maximum values for the previous week.

<table>
<thead>
<tr>
<th>Monday</th>
<th>Tuesday</th>
<th>Wednesday</th>
<th>Thursday</th>
<th>Friday</th>
<th>Saturday</th>
<th>Sunday</th>
</tr>
</thead>
</table>

(Other Ozone Action Links: EPA Region 5 OzoneAction! SEMCOG OzoneAction!)

Data Sources: AMU- Ambient Data M&M Unit- Meteorological Data

Ozone Values Lake Michigan Area: Illinois

Revised May 15, 1997
by Mary Ann Heindorf

http://www.deq.state.mi.us/aqd/eval/amu/o3action.html
<table>
<thead>
<tr>
<th>AIR QUALITY</th>
<th>WEATHER CONDITIONS</th>
<th>RECOMMENDED ACTIONS</th>
<th>WHEN AIR QUALITY IS IN THE MODERATE RANGE, RESIDENTS SHOULD:</th>
</tr>
</thead>
</table>
| Moderate    | ● Temperatures mid to low 90's  
● Light winds  
● Slow moving system  
● Air quality is in the moderate range  
● High pressure system with partly cloudy or sunny skies  
● Temperatures (upper 70's to mid 80's)  
● Light to moderate winds (15 knots or less)  
● High pressure system with partly cloudy or sunny skies  | ● Consolidate trips and errands.  
● Limit idling when possible.  
● Conserve electricity and set air conditioners to 78°F | ● Cool summer (mid 70°F)  
● Windy conditions (30 knots or higher)  
● Heavy or steady rain  
● Passing cold front clears pollution out of area  
● Temperatures (upper 70's to mid 80's)  
● Light to moderate winds (15 knots or less)  
● High pressure system with partly cloudy or sunny skies |
THE AIR QUALITY INDEX

The Air Pollution Control District of Jefferson County issues a POLLUTANT STANDARD INDEX 4 times daily during the weekdays. The Air Quality Index provides the current index, the elevated pollutant, the current category, and a short term forecast.
The Latest Air Quality Index for Louisville

INFORMATION FROM THE KENTUCKIANA OZONE PREVENTION COALITION

We often hear a lot about the depletion of the ozone layer in the atmosphere. This kind of ozone protects us from harmful radiation. Stratospheric ozone is good, but ground-level ozone is harmful.

When people think of ground-level ozone, they usually picture a thick layer of smog over Los Angeles. They don't usually think of a Midwest summer day, typically hazy, sunny and hot.

WHAT EXACTLY IS GROUND-LEVEL OZONE?

Ground-level ozone is formed by a chemical reaction between volatile organic compounds (VOCs) and oxides of nitrogen in the presence of sunlight and warm temperatures. The primary source of these are automobiles and industrial emissions. High ozone levels pose significant health risks to the elderly and young children, but even healthy adults may be affected. Here in Kentuckiana, ground-level ozone is a particular problem during the afternoons and early evenings between June and September.

Most of the pollutants that form ozone come from cars. Large factories account for another portion of the emissions. Small businesses such as printing plants, service stations, and auto body shops, and people using lawn mowers, paints, and cleaning solvents account for another portion of the emissions.

WHY SHOULD YOU CARE ABOUT THE AIR YOU BREATHE?

High ground-level ozone directly impacts our health and our economy. When ozone is breathed into the body, it reacts with the lung tissue. It can harm breathing passages, making it more difficult for the lungs to work. It also can cause eye and throat irritation and cause a greater susceptibility to infection.

If Kentuckiana continues to exceed federal standards, numerous costly restrictions - which will affect businesses and private citizens alike - will be required in our area. By making a few simple changes in our daily habits, we can maintain healthy air and a healthy economy.

When weather forecasts show favorable conditions for high ozone levels, the Kentuckiana Ozone Prevention Coalition will issue an Ozone Action Day advisory asking you to do your share for cleaner air.

YOUR GUIDE TO THE POLLUTANT STANDARDS INDEX

<table>
<thead>
<tr>
<th>CATEGORY</th>
<th>PSI</th>
<th>COLOR CODE</th>
<th>HEALTH STATEMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good</td>
<td>51 - 70</td>
<td>green</td>
<td>None</td>
</tr>
<tr>
<td>Moderate</td>
<td>70 - 79</td>
<td>yellow</td>
<td>None</td>
</tr>
</tbody>
</table>
The Ozone Forecasting Program

Using a formula developed by the University of Maryland, the Maryland Department of the Environment forecasts ozone levels for the Baltimore and Washington, D.C. metropolitan area. MDE also gives current ozone levels which are measured at MDE monitoring sites throughout the state. The information is communicated to outside parties immediately, by fax, throughout the summer ozone season (May - September).

Based on the forecasts, the public can take measures to protect themselves from exposure if they're vulnerable and contribute to reducing emissions by actions such as: keeping cars well tuned, mowing less with a gas mower, or using an environmentally friendly mower, refueling after dusk to prevent the daytime releases of pollution, using water-based paints and citrus-based cleaners.

Each day, MDE will fax pre-approved "green," "yellow," "orange," and "red" labeled messages at 4:30 P.M., depending on the level of ozone. If the forecast changes, a subsequent forecast will be issued at 11:30 the following morning. The faxes will be distributed by computer to local media. When a violation occurs, an immediate "Notice of Unhealthful Air" is issued and faxed to all parties.

The Maryland Department of Transportation also reports MDE's ozone messages on the overhead highway signs throughout the state.

The Maryland Department of the Environment maintains a toll free telephone number to answer the public's questions on the ozone levels. The number is 1-800-539-6656. The Department's Air Quality Hotline, (410) 631-3247, gives the current pollutant standard index readings, and its color coded correspondent, a color coded forecast, and preventive measures for people to follow.

<table>
<thead>
<tr>
<th>Pollutant Standard Index Reading (PSI)</th>
<th>Corresponding Color Coded Forecast</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-50</td>
<td>Code Green</td>
</tr>
<tr>
<td>51-88</td>
<td>Code Yellow</td>
</tr>
<tr>
<td>89-99</td>
<td>Code Orange</td>
</tr>
<tr>
<td>100+</td>
<td>Code Red</td>
</tr>
</tbody>
</table>

- **Code Green**: good air quality—ozone levels to be less than 61 parts per billion (ppb)
- **Code Yellow**: moderate air quality—ozone levels to be between 61 and 110 ppb
- **Code Orange**: approaching unhealthy—ozone levels to be between 111 and 124 ppb
- **Code Red**: unhealthy air quality—ozone levels to be equal to or greater than 125 ppb

Back to the Ozone Information Page
Appendix E

EXAMPLE SURVEY FOR QUANTIFYING PUBLIC AWARENESS
INTRODUCTION

Hello, my name is ___________ with ___________. We are conducting a _____ minute survey on import public policy issues in [insert name of city]. Your participation is important to us and we ensure that any responses you provide will be STRICTLY CONFIDENTIAL. Would you mind answering a few questions?

START SURVEY

Screening Question (e.g., employment status, driving status, age)

- Public Perception of Air Pollution Problem -

I am going to read you a list of local public policy issues. Which of the following is the most important issue to you?

- crime
- public education
- environment/pollution
- economy
- health care
- transportation

Now, I am going to read you a list of local environmental problems. Which of the following is of most concern to you?

- disposal of solid waste
- water pollution
- air pollution
- habitat preservation/preserving biodiversity

In general, how would you rate [insert name of city]'s overall air quality?

- very good
- good
- fair
- poor
- very poor

Do you consider air pollution to be a problem in [insert name of city]?

How serious a problem is air pollution in [insert name of city]? Would you say that air pollution is...

- very serious
- somewhat serious
- slight problem
- not a problem at all

Over the past five years, do you think that air pollution in [insert name of city] has improved, gotten worse or stay about the same?

During the next five years, do you expect air pollution in [insert name of city] to improve, get worse or stayed the same?

- **Public Knowledge of Air Pollution Issues** -

Which of the following weather conditions, if any, do you believe lead to poor air quality in [insert name of city]?
- hot, still weather
- cold, still weather
- rain
- wind
- don’t know
- same

Do you think that air pollution affects public health? Would you say air pollution is...
- not at all harmful to public health?
- not very harmful to public health?
- somewhat harmful to public health?
- very harmful to public health?

What would you say is the major cause of air pollution in [insert name of city]?
- fireplaces
- automobiles
- agricultural burning
- trucks/buses/diesel vehicles
- location/weather/pollutant transport from other regions
- industry/manufacturing
- gas-powered garden equipment (lawnmowers, leaf blowers etc)
- aerosol sprays and other consumer products
- outdoor barbeques

What things can residents of [insert name of city] do to reduce pollution on days of poor air quality?
- drive less
- ride with someone else (car/vanpool)
- combine multiple trips throughout the day
- use transit instead of driving
- walk or bike instead of driving
- work at home (telecommute) instead of driving to the main workplace
- refuel after 6pm
- use of electric-powered garden equipment (lawn mowers, leaf blowers, etc)
- refrain from using aerosols and other consumer products
- tune-up car
### Awareness of the Program and its Outreach Efforts

In the past (week/month/year), have you seen or heard anything about air pollution in [insert name of city]...
- on the radio?
- on television?
- in the newspaper?
- where you work?
- from friends or neighbors?
- from community or environmental groups?
- other?

Could you describe what you saw or heard?  [open-ended question]

In the past (week/month/year) have you seen or heard any air pollution ...

| Slogans? | Name of slogan: ________________ |
| Mascots? | Describe mascot: ________________ |
| Air quality symbols? | Describe symbol: ________________ |

Are you familiar with the Ozone Alert! program or its slogan: ‘Ozone Alert!’?

What does Ozone Alert! mean to you?
- don’t know
- limit driving
- limit use of gas-powered garden equipment
- limit use of barbecue
- limit use of aerosols/consumer products

[ Tell the respondent the goals of the program - reduce pollution on poor aq days ]

### Recognition Level of Implementing Agency

What agency or agencies do you think is/are responsible for keeping the air clean in [insert name of city]?
- EPA
- health department
- state government
- [insert name of city] Air Pollution Control Agency

Have you ever heard of the [insert name of city’s Air Pollution Control Agency]?

To the best of your knowledge, what does the [city’s Air Pollution Control Agency] do?
- monitor air pollution
- issue burn bans
- give warnings on air pollution to the media
- educate/inform the public
- regulate/control/enforce emissions from industry
- don’t know
What is your impression of the [insert name of city’s Air Pollution Control Agency]?
- very positive
- somewhat positive
- somewhat negative
- very negative
- neutral
- don’t know

- Statistical Information -

*Finally a few questions for statistical purposes.*

What is your...
- Age
- Gender
- Income
- Educational level
- [Employment status]

CLOSE – COMPLETED SURVEY

This completes our survey. Thank you very much for participating.

CLOSE – RESPONDENT DISQUALIFIED

ADDITIONAL INFORMATION (if requested by respondent)

Survey conducted by:
Survey funded by:
For further information contact:

Additional Questions which could be included:
- reasons for maintaining good air quality (health, visibility, environment etc.)
- reasons for allowing pollution (businesses, economy, personal freedom, etc)
- motivations for using auto less
- personal responsibility to clean up air
- what respondents feel they can do
Appendix F

EXAMPLE SURVEY FOR QUANTIFYING CHANGES IN BEHAVIOR
INTRODUCTION

Hello, my name is __________ with __________. We are conducting a ____ minute survey on import public policy issues. Your participation is important to us and we ensure that any responses you provide will be STRICTLY CONFIDENTIAL. Would you mind answering a few questions?

START SURVEY

Screening Question (e.g., employment status, driving status, age)

- Travel Behavior -

Now I would like to ask some questions about the travel you took today.

Did you make trips outside the home today? [No, skip to XX]

Did you travel by automobile? [No, skip to XX]

How many automobile trips did you take...
  ... in the morning (6am - 11am)?
  ... in the afternoon (11am - 3pm)?
  ... in the evening (3pm - 8pm)?

Definition: A trip is defined as travel from one place to another by any means of transportation. For example, a stop at the grocery store after work and then going home counts as two trips.

Approximately how many miles did you travel by automobile?

Did you refuel your vehicle today? [No, skip to XX]

At what time of the day did you refuel?
  - (6am - 11am)?
  - (11am - 3pm)?
  - (3pm - 8pm)?
  - (8pm -5am)?
Why did you not refuel your vehicle today? [unprompted]

Do you recall being asked to refuel your vehicle after 6pm or on another day because of bad air quality? yes/no

In response to this request, did you actually postpone refueling until after 6pm or until another day?

---

Change in Behavior / Causality

Did you drive your automobile more frequently, less frequently, or the same today as you usually do? [Skip to XX if more or the same is chosen] ...more, less, the same

Why did you make that change? {only ask to people who respond that they drove less} [unprompted]

Do you recall being asked not to drive today because of bad air quality? yes/no

In response to this request not to drive, did you ACTUALLY reducing your driving? yes/no

What did you do instead of driving?
- delay trips to another day
- ride with someone else (car/vanpool)
- use transit
- walk
- bike
- work at home (telecommute)

{If transit or carpool/vanpool} Did you drive to a Park-and-Ride lot and then take {transit or carpool/vanpool}?

How many vehicle trips/VMT did you not take by...
{insert the alternative travel mode response(s) from previous question}

Was your vehicle used by someone else within your household while you were ...
{insert the alternative travel mode response(s) from the question before last}

---

Typical Auto-use

Now I would like to ask you some questions about your typical travel patterns.

Do you have access to an automobile?

On average, how many miles do you drive per week by automobile?

What is the approximate one-way distance (in miles) from your home to your workplace?
What mode of travel do you typically use to get to work?
- SOV
- transit
- carpool/vanpool
- other

Did you travel by other means of transportation? [No, skip to XX]

Which alternative modes of transportation did you take?
- transit
- carpool/vanpool
- walk/bicycle
- other

{If transit or carpool/vanpool} Did you drive to a Park-and-Ride lot and then take {transit or carpool/vanpool}?

How many trips did you take by {insert mode(s) chosen in question above}? 
- transit
- carpool/vanpool
- walk/bicycle
- other

---

* Household Activities *

Now I would like to ask you several questions about your household activities.

Did you use {insert area source category} today?

Did you use {area source category} more or less frequently today than normally? [Skip to XX if more or the same is chosen]  Choices: same [skip to ..] more, less

Did you intentionally choose to use {area source category} less today?

Why? [ unprompted]

Do you recall being asked not to use {area source category} because of bad air quality? [ prompted]

In response to this request not to do these activities, did you ACTUALLY reduce the use of {area source category}?

[^1] Examples of area source categories of pollution that a region may want to collect data on include painting, gas-powered garden tool use (e.g., lawn mowers) and use of consumer products that affect air quality (e.g., aerosol sprays)
• **Awareness of the Program and its Outreach Efforts** •

In the past (week/month/year), have you seen or heard anything about air pollution in [insert name of city]...
- on the radio?
- on television?
- in the newspaper?
- where you work?
- from friends or neighbors?
- from community or environmental groups?
- other?

Could you describe what you saw or heard?  [open-ended question]

In the past (week/month/year) have you seen or heard any air pollution ...
- slogans?  Name of slogan: ____________
- mascots?  Describe mascot: ____________
- air quality symbols?  Describe symbol: ____________

Are you familiar with the Ozone Alert! program or its slogan: ‘Ozone Alert!’?

What does Ozone Alert! mean to you?
- don’t know
- limit driving
- limit use of gas-powered garden equipment
- limit use of barbecue
- limit use of aerosols/consumer products

• **Statistical Information** •

Finally a few questions for statistical purposes.

What is your...
- Age, Gender, Income, Educational level, Employment status

CLOSE — COMPLETED SURVEY

This completes our survey. Thank you very much for participating.

CLOSE — RESPONDENT DISQUALIFIED

ADDITIONAL INFORMATION (if requested by respondent)

Survey conducted by:  
Survey funded by:  
For further information contact:  
Include definitions of key terms (i.e. trip, VMT) so the interviewer can clarify issues which may be confusing to the respondent.
Appendix G

EXAMPLE EMISSION CALCULATION
Calculating Emission Reductions

Areas may need to quantify the emissions impacts of their CAP for evaluation purposes or for documenting emission reduction claims included in a SIP. The overall objective of this type of an exercise is to compare the amount of emissions produced under normal conditions with the amount produced on a pollution episode day to see whether emissions are being reduced in response to the CAP. To perform this comparison, an emission reduction calculation can be completed for each emission-producing activity that a program is designed to target. For example, a program targeting summertime ozone pollution may be designed to encourage the general public to reduce the following types of activities: personal vehicle use, use of gas-powered lawn maintenance equipment (e.g., lawn mowers), and use of consumer products that affect air quality. To quantify the total emission impacts of a program, the emission reductions associated with each of these categories of activities will need to be calculated. A schematic of the basic procedure for performing these emissions calculations is shown in Figure G-1.

As seen in Figure G-1, emission reduction calculations are completed by multiplying the level of activity reduced (e.g., number of vehicle miles traveled reduced) by the emissions factor associated with that activity (e.g., grams of pollution per vehicle mile). Emissions factor data are available for many types of emission-producing activities. These data are highly variable, however, depending upon many factors such as the engine type, how it is being used, and the ambient temperature. To ensure that the appropriate emission assumptions are used in a calculation, areas should consult with the local MPO or state and local air quality planning agency. While emission factor data are readily available through local, state or federal agencies, activity data often need to be collected on a program by program basis through surveying or another method. Note that determining the level of activity reduced on an Alert day requires having activity data on both an Alert day and a normal day. Therefore, many areas collect data before the pollution season starts to get a baseline measurement of activity, and then again on a pollution episode day. If the data are collected correctly and are deemed reliable, the differences in measurements taken under these two conditions represents the travel behavior change that results from the program.

![Figure G-1. Procedure for calculating emissions reductions](image-url)
Example Emissions Calculation

There are several different approaches that can be used to estimate the changes in activity necessary for conducting an emissions calculation. For example, areas can ask respondents whether they reduced their travel on a pollution episode day, and if so, by how much. This method, however, relies on the respondent having accurate recall and being able to do a relative comparison of their travel on the episode day compared to their normal travel patterns. An alternative method that avoids this problem is to survey respondents on two different occasions, asking them about their travel on a pollution Alert day and then again on a normal day to see whether there are any differences. The following example calculation demonstrates the later method.

The following example is provided solely to demonstrate a frequently-used emissions calculation method. The sample data used to complete the calculation do not represent actual data from any particular program. Areas performing emissions calculations may need to collect travel behavior data (e.g., using a survey) and make adjustments to the following approach based on data availability. Further, programs should consult with the local MPO or state and local air quality planning agency to obtain the necessary data and to ensure that any assumptions used are appropriate.

To complete the example calculation, the following assumptions are made:

- Program objective – summer ozone program designed to reduce ozone precursor (HC & NOx) emissions on pollution episode days by encouraging reductions in personal vehicle use.

- Sampling – A single group of 1,000 drivers are randomly sampled from a total population of 500,000 drivers (Table G-1). Travel activity data from the sample group is collected on two occasions: (1) before the ozone season (Baseline), and (2) on an ozone episode day during the summer (Alert day).

- Data collected are separated into two groups for comparison: (1) Participants – those people who on the Alert day survey indicated that they reduced their vehicle travel in response to the program’s request to reduce pollution. For this calculation, we assume that 5% of the sample population (50 of the 1,000 sampled) are participants; (2) Non-participants – those people who did not change behavior in response to the program.

For the participant group, baseline travel data (the number of trips) collected can be compared to data collected on the pollution episode day to assess any differences in travel behavior in response to the program (Table G-2). Differences in the number of trips taken on a normal day and a pollution episode day can be multiplied by local average trip length data to estimate the difference in vehicle miles traveled (VMT). This comparison can be repeated for data from the non-participant group which can serve as a control measure with which to compare findings.

As shown in Table G-3, the travel reductions measured for the participant group on pollution episode days can be extrapolated to the total driving population at large to estimate the region-wide travel impacts of the program. The resulting travel reductions
are then multiplied by the appropriate mobile source emission factors (EF) to yield the total emission savings from the program.

Table G-1. Example populations and sample sizes

<table>
<thead>
<tr>
<th>Total driver population</th>
<th># drivers sampled</th>
<th>% drivers sampled that participate</th>
<th># drivers sampled that participate</th>
<th>Total # drivers that will participate¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>500,000</td>
<td>1,000</td>
<td>5%</td>
<td>50</td>
<td>25,000</td>
</tr>
</tbody>
</table>

¹ Calculated by multiplying the driver participation rate (5%) by the total driver population. This extrapolation assumes that the random sample of drivers is representative of the population as a whole.

Table G-2. Comparison of participant’s vehicle travel before the ozone season (Baseline) and on a pollution episode day (Alert day) (n=50)

<table>
<thead>
<tr>
<th></th>
<th>(1) Baseline</th>
<th>(2) Alert day</th>
<th>(3) Difference between (1) &amp; (2)</th>
<th>(4) % Difference between (1) &amp; (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td># vehicle trips per day</td>
<td>175</td>
<td>165</td>
<td>10</td>
<td>-5.7%</td>
</tr>
<tr>
<td># trips per person-day</td>
<td>3.5</td>
<td>3.3</td>
<td>0.2</td>
<td>-5.7%</td>
</tr>
</tbody>
</table>

Table G-3. Calculating participant’s emissions reductions on the ozone Alert day and extrapolating results to the general population

<table>
<thead>
<tr>
<th>(1) Total # participants</th>
<th>(2) # trips reduced (trips/day)</th>
<th>(3) Total # trips reduced (1) x (2)</th>
<th>(4) Total VMT reduced²</th>
<th>(5) HC EF (grams per mile)</th>
<th>(6) NOx EF (grams per mile)</th>
<th>(7) HC emissions reduced (kg) (4) x (5)</th>
<th>(8) NOx emissions reduced (kg) (4) x (6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>25,000</td>
<td>0.2</td>
<td>5,000</td>
<td>30,000</td>
<td>2.3</td>
<td>2.4</td>
<td>69</td>
<td>72</td>
</tr>
</tbody>
</table>

² Assumes an average trip length of 6 miles.
Appendix H

EXAMPLE OZONE MAP
Summer 1997 High Ozone Day

June 21 1997

The map above is based on an interpolation of the actual maximum daily hourly values at approximately 200 ground-level ozone monitoring sites from Maine to North Carolina. Note that values over water may be inaccurate due to a lack of monitoring data.

The key to the map is based on EPA's Pollutant's Standards Index. Based on EPA's National Ambient Air Quality Standard (NAAQS) for ground-level ozone, air quality is considered unhealthful when hourly monitoring values of 125 parts per billion (ppb) or more are recorded.