Ground-Level Ozone:
Myth, Facts, and Politics

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Ground-level ozone, often referred to as smog, is front and center on the policy agenda of environmental groups and legislators at all levels of government. Ozone is not directly emitted from either smokestacks or tailpipes. Instead, it occurs as a result of a chemical reaction between volatile organic compounds (VOCs) and emissions of nitrogen oxide (NOx) that occur in the presence of sunlight and heat. VOCs refer to a number of gasses that are emitted in the air from many sources including gasoline at gas pumps, open paint cans, chemicals from dry cleaners, and even trees and insects. NOx is also emitted naturally but the primary concern has been with human-instigated emissions that are the result of coal-fired power plants and automobiles.

Over the past several years, high-profile studies published by the American Lung Association, the Public Interest Research Group (PIRG) and the Clean Air Network (a consortium of environmental advocacy groups) have claimed that ozone is having a severe impact on public health, nationwide and in North Carolina. Statements such as "pollution from…power plants sends tens of thousands of Americans, primarily children, to emergency rooms each summer, and contributes to thousands of premature deaths each year" have served to scare the public while doing very little to advance scientific understanding. In North Carolina these arguments were the impetus behind the multi-billion-dollar Clean Smokestacks legislation that was passed in 2002. In addition they are being cited by a statewide energy policy task force to justify a host of additional new restrictions on energy consumption.

But there is a great deal of controversy surrounding the issue of ground-level ozone. For example, while there is no dispute that ozone, when inhaled, can cause lung irritation, there is not agreement concerning the minimum concentration levels at which these effects kick in. Furthermore, data in North Carolina relating high ozone days to childhood hospital admissions for asthma actually show that counties with the fewest high ozone days often have the highest hospitalization rates. These results are exactly opposite of those being suggested by environmental advocacy groups and even the North Carolina's Division of Air Quality. Furthermore, since ground-level ozone protects people from the ultraviolet rays of the sun and therefore contributes to reduced incidences of skin cancer, some studies suggest that current ozone standards my be doing more harm than good.

As the environment becomes cleaner and cleaner, further attempts to "scrub" away all human impacts on the air, land and waterways become increasingly costly. Because of this, a well-informed electorate is more important than ever. Unfortunately, the information mill on these issues tends to be controlled by environmental pressure groups and bureaucrats who have a personal stake in the outcome, with enlightened democracy as its main casualty.

Introduction

Ground-level ozone, often referred to as smog, is front and center on the policy agenda of environmental groups and legislators at all levels of government. Over the past several years, high-profile studies published by the American Lung Association, the Public Interest Research Group (PIRG) and the Clean Air Network[1] (a consortium of environmental advocacy groups) have claimed that ozone is having a severe impact on public health, both nationwide and in North Carolina. These reports have gotten a great deal of media attention but very little media scrutiny. Statements such as "pollution from…power plants sends tens of thousands of Americans, primarily children, to emergency rooms each summer, and contributes to thousands of premature deaths each year"[2] have served to scare the public while doing very little to advance scientific understanding. (See appendix for actual data on this relationship for North Carolina.) Unfortunately, this kind of hysteria is being used to argue for an array of new regulations primarily related to the use of automobiles and the generation of electric power. In North Carolina, the problems that ground-level ozone are allegedly causing were the impetus behind the multibillion-dollar Clean Smokestacks legislation that was passed in 2002. In addition they are being cited by a statewide energy policy task force to justify a host of additional new restrictions on energy consumption.[3]

The problem is that there is a great deal of controversy surrounding the issue of ground-level ozone. As will be noted, serious questions still exist relating to the health effects of ozone and whether current standards may actually end up doing more harm than good. Also, the way in which ozone levels are measured and reported can often be misleading and tend to promote the demagogic use of data by special-interest advocacy groups.

I. What is Ground-level (Tropospheric) Ozone?

First, it should be made clear that in this discussion we are not referring to "the ozone layer," known as stratospheric ozone, which is a layer of ozone that is six to 30 miles above the Earth's surface, well above ground level. The concern with stratospheric ozone is that it is being depleted and, therefore, its role in filtering out the ultraviolet rays of the sun and protecting people from skin cancer is being lost. Instead, we are talking about "tropospheric" or ground-level ozone, which is ozone that is formed in the layer of atmosphere closest to the Earth and is therefore inhaled. Ozone, when inhaled at certain intensities and by certain groups, is a respiratory irritant. (Ground-level ozone, like stratospheric ozone, is also a sunscreen. And this is where some of the controversy regarding "safe levels" of ozone arises. This issue will be discussed at greater length below.)

Ozone is not directly emitted from either smokestacks or tailpipes. Instead, it occurs as a result of a chemical reaction between volatile organic compounds (VOCs) and emissions of nitrogen oxide (NOx) that occurs in the presence of sunlight and heat. VOCs refer to a number of gasses that are emitted in the air from many sources, including gasoline at gas pumps, open paint cans, chemicals from dry cleaners, and even trees and insects. For this reason,

sometimes relatively high natural background levels of ozone will occur in heavily forested areas of the country like the Southeast, where there can be both high levels of naturally occurring VOCs and intense sunlight. Therefore, ozone is not strictly a product of human-generated pollution. NOx is also emitted naturally, for example from the soil and from lightning, but the primary concern has been with human-instigated emissions that are the result of coal-fired power plants and automobiles.

Since sunlight and heat are essential ingredients for the formation of ozone, it is likely to be at its highest levels when the sun is most intense; that is, in the late spring and summer months (May to September), between midmorning and late afternoon. Also, ozone concentrations tend to be very localized. In a given city one ozone monitor may have a particularly high reading, while a few blocks away, another monitor may show relatively low ozone levels. Because of this, reports of high ozone tend to be misleading. Typically, if only one high-ozone reading on one monitor in a city, county or region is recorded on a particular day, the entire area will be characterized as having a bad or "unhealthy" ozone day. For example, in the summer of 2001, it was reported that the Triad area of North Carolina (including Winston-Salem, Greensboro and High Point) had "23 days of unhealthy air quality." In reality, the highest number of exceedance days registered by any single location in the region was 11, and the average number of exceedance days per monitor in the area was a little over seven.[4]

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Ozone is measured in terms of parts per billion (ppb) of ambient air. Over the past several years there has been considerable controversy over the issue of what constitutes dangerous levels of ozone. New standards were initially approved by the Clinton EPA in 1997 but will not be fully implemented for several more years because of litigation-related delays. From 1979 to 1997 the EPA had recognized an ozone exceedance when a monitor in a particular location reads 120 ppb for one hour over the course of a 24-hour period. Most of the country has been, and is now in compliance with this standard. Using this standard, from 1980 to 2000 the U.S. experienced a 21% decrease in ozone. Furthermore, this trend was observed in every geographic area.[5]

In 1997 the EPA approved a change in the National Ambient Air Quality Standards (NAAQS) from the 120 ppb / one hour standard to 80 ppb over eight hours for a 24-hour period. For the last five years this standard has faced a series of legal challenges from both industry and judges, who have suggested that the supporting science was incomplete. Consequently, the standard has not officially been put in place at the federal level. On the other hand, many states, including North Carolina, have implemented the standard unilaterally. Furthermore, in anticipation of an eventual official change at the federal level, the 80 ppb standard has become the de facto threshold level for both environmental groups and media reports on the issue. It should also be noted that according to the EPA, "over the last 20 years, ozone [using the 80 ppb standard] has improved considerably nationwide." In fact, using the

newer standard, there has been a 12% decline.[6] In North Carolina, using average numbers of ozone-exceedence days on an annual basis, there has been neither an increasing or decreasing trend for the last eight years (see appendix).

II. Health Impacts: A Matter of Comparative Risks

Those who emphasize ozone pollution as a primary reason for new legislation mandating dramatic reductions in NOx emissions, such as the Clean Smokestacks legislation recently passed in North Carolina, are quick to emphasize the fact that ozone can be a significant lung irritant. This is not controversial, although what segment of the population is being exposed, for how long, and at what level are all important issues that are very often ignored.[7] Also ignored, not only by advocacy groups but by government agencies including the EPA and the North Carolina Division of Air Quality, is the fact that ground-level ozone, like stratospheric ozone, acts as a sun screen and therefore has health benefits. Reductions in ozone levels will, therefore, have health-related costs as well as benefits that should be, but are not considered when evaluating regulations to reduce ozone.

A. Respiratory Health Effects of Ozone: Certainties and Uncertainties

As noted, the fact that ozone causes respiratory problems is uncontroversial. In general, otherwise healthy individuals will suffer with ozone-related problems only at relatively high levels.[8] The levels will vary depending on the amount of physical exertion. For example, the typical healthy individual at rest will experience statistically significant "pulmonary function decrements" at exposures of over 500 ppb over a one to three-hour period. On the other end of the range, the same individual will, while running (considered "very heavy" exercise), show problems beginning at exposures to ozone levels of 160 ppb over a one to three-hour period. For some healthy individuals negative effects will show up at lower levels over a longer period. For example, at the 80 ppb level of exposure, 5% would experience noticeable "beyond the range of normal variability" pulmonary problems under conditions of moderate exercise (brisk walking) if the exercise were sustained over a six to eight-hour period.

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Those who are most at risk for ozone-related problems are unhealthy individuals, particularly those with pre-existing respiratory conditions such as asthma. These sensitive groups are the targets of the 80 ppb standard. As pointed out by the EPA, "while group mean responses in clinical studies at the lowest exposure level tested of 80 ppb are typically small or mild in nature, responses of some sensitive individuals are sufficiently severe and extended in duration to be considered adverse."[9] It is important to note also that even within these groups, the negative effects are not thought to be long lasting. That is, they tend to subside when ozone levels fall or when the exposed individual is taken out of the high-ozone environment, i.e., brought indoors. According to the EPA, "with regard

to lung function decrements and respiratory symptoms…O3 (ozone)-induced effects are transient and reversible…"[10]

The controversy centers around two issues. The first relates to the levels at which the "at risk" populations face significant problems. The second relates to whether the reduction of the risks through tighter standards outweigh an increase in risk from more intense exposure to UV-B rays.

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The primary issues relating to the negative health effects of ozone have been articulated by the EPA's own Clean Air Scientific Advisory Committee. CASAC was established by the CAA to "assist in the development of air quality criteria."[11] In this role the committee reviews regulations and supporting documents issued by the EPA to make sure that they "accurately reflect the latest scientific knowledge…"[12]

CASAC's reviews of the 80 ppb, eight-hour standard were clearly mixed. First, members of the panel agreed with EPA's definition of the relevant "at risk" population, namely "outdoor children [and] outdoor workers…with pre-existing respiratory disease…" They also agreed that "an 8-hour standard was more appropriate for a human health-based standard than a 1-hour standard." Indeed, "the Panel was in unanimous agreement that the present 1-hour standard be eliminated and replaced with an eight-hour standard."[13] In other words, CASAC agreed with EPA that the one-hour exposure time was too short to truly capture the desired health-related benefits of the regulations.

CASAC's disagreement with EPA arose in evaluating the health effects of the 80 ppb threshold, and the disagreements were not trivial. At the time EPA was considering a range of possibilities from 70 to 90 ppb. Clearly there is no disagreement over whether ozone has negative effects on respiratory health. The controversy is over the relative health effects at alternative levels. The statements below illustrate the controversy and CASAC's concerns:[14]

- "based on the results presented in these and other similar tables presented in the Staff Paper, the Panel concluded that there is no bright line which distinguishes any of the proposed standards (either the level or the number of allowable exceedances) as being significantly more protective of public health."

- "the differences in the percent of outdoor children responding between the present standard [120 ppb] and the most stringent proposal [70 ppb] are small."

- "there was considerable concern that the criteria for grading physiological and clinical responses to ozone was confusing if not misleading."

- "when ozone-aggravated asthma admissions are compared to total asthma admissions

the difference between the various options are small. Consequently, the selection of a specific level and number of allowable exceedances is a policy decision."

- "because of myriad assumptions that are made to estimate population exposure and risk, large uncertainties exist in these estimates."

- "the ranges are not reflective of all of the uncertainties associated with the numerous assumptions that were made to develop the estimates."

- "The Panel felt that the weight of the health effects evidence indicates that there is no threshold concentration for the onset of biological responses due to exposure to ozone above background concentrations."

- "the paradigm of selecting a standard at the lowest-observable-effects-level and then providing an 'adequate margin of safety' is no longer possible."

B. Code Orange, Code Red, and Code Purple

Beyond the 80 ppb standard, ozone-exceedence days are color-coded according to how detrimental their health effects might be. The standard thresholds, which have been adopted in North Carolina and elsewhere, are:

Code Orange: 85 to 104 ppb, unhealthy for sensitive groups
Code Red: 105 to 124 ppb, unhealthy
Code Purple: 125 and above, very unhealthy

For most of the country, Code Reds and Code Purples occur very infrequently. Indeed, it is not at all unusual for most areas to go an entire ozone season without experiencing any concentration above a Code Orange.

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There are several problems surrounding this system. First, as is clear from CASAC's conclusion noted in the previous section, there is not a scientific consensus on thresholds at which adverse pulmonary health effects kick in. Certainly the effects are not as clear as the color codes would indicate.

Second, there are problems with the way the conditions on a given day are reported to the public. The idea is that the system is supposed to alert people to air quality problems in a concise, easy to understand manner, but in fact the reporting of these days can be misleading and can unduly panic the population. Much of this relates to the localized nature of ozone. For example, June 11, 2002 was reported as a Code Red day in North Carolina's Triangle region. But the region, as defined by the state for air-quality purposes, includes all or parts of five counties and has nine ozone monitors. On that day, only one of those monitors registered

a Code Red, and that monitor was located in the town of Franklinton, well away from the major population centers of Raleigh, Durham, and Chapel Hill. In reality the vast majority of people living in the Triangle area did not experience Code Red ozone conditions. This fact was never reported.

Finally, on any given day, Code Orange, Code Red or Code Purple alerts are issued to the media and the public, first thing in the morning or the night before. The problem is that if conditions improve, the alert is never downgraded. So if a Code Red alert is issued, it immediately gets publicized by radio and television and continues to be reported throughout the day. But if conditions change by 10 a.m., for example, the alert is not rescinded and the media continues to issue what is actually a false alert.

C. The Myth of Good and Bad Ozone: UV-B Radiation, Skin Cancer and Cataracts

"…you've probably heard a great deal about the importance of the "ozone layer" and how it protects us from the sun's harmful ultraviolet rays. The atmospheric ozone found 10 to 30 miles above the Earth's surface—is good. But, ozone at the ground-level is bad."

— North Carolina Department of Health and Human Services[15]

This statement reflects a widely held myth that is propagated by both environmental advocacy groups and many government agencies. Unfortunately it is a position that has also been adopted by the North Carolina Division of Air Quality in its materials used to explain the science of air pollution to school children.[16]

It is well established in the scientific literature that ground-level ozone, like stratospheric ozone, is a sun screen that protects people from UV-B radiation and, therefore, reduces incidences of both skin cancer and cataracts. As noted in *Environmental Science and Technology News*, "Tropospheric ozone…reduces human exposure to damaging ultraviolet-B radiation in a manner similar to ozone in the stratosphere."[17] This implies that there is a trade-off in setting ozone standards. Ground-level ozone is not unambiguously harmful. The benefits associated with reducing ground-level ozone can be offset by increased exposures to the sun's ultraviolet rays.

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The issue that must be looked at with respect to protection from UV-B radiation has to do with average ozone levels over time, rather than peak ozone levels at points in time (ozone-exceedance days), as is the case when considering ozone's negative pulmonary effects. The problem is that in order to reduce the latter, one must also reduce the former. According to Lutter and Wolz, "the nonmelanoma skin cancers resulting from a 10ppb decline in tropospheric ozone…would range from 4,200 to 8,100 cases per year" at a cost of $.29 to $1.1 bil-

lion.[18] The Department of Energy has also attempted to estimate the effects of a 10 ppb reduction in ozone and has concluded that it would result in an additional 13,000-28,000 cataracts per year and 25 to 50 annual deaths caused by melanoma skin cancers.[19]

When setting ozone standards, then, the public policy issue is one of comparative risks. That is, are the risks that will be avoided in terms of "pulmonary degradation" by any given ozone standard, be greater or less than the risks that will be incurred in terms of skin cancers and cataracts? There have been several studies that have looked at this question and attempted to quantify the results. In the paper by Lutter and Wolz, cited above, it was concluded that the 80 ppb standard would generate no net health benefits. "Our preliminary analysis suggests that the value of increased UV-B-related health effects from tropospheric ozone reductions may be similar in magnitude to the value of decreased respiratory health effects."[20] In preparing extensive comments on the 80 ppb ozone standard for the Center for the Study of Public Choice at George Mason University, Susan Dudley concluded that "the proposal could result in negative health benefits of $282 million" per year.[21] That is, the 80 ppb standard as adopted by North Carolina could actually be generating net harm. Since the state does not officially recognize the fact that ground-level ozone generates any benefits, it is not surprising that the Division of Air Quality did not consider these benefits when choosing to adopt the 80 ppb threshold. Likewise, the legislature, in adopting the Clean Smokestacks bill, made no inquiries regarding the effects of the legislation on skin cancer or cataracts. In fact, there was no cost-benefit analysis of any kind to justify enactment of the legislation.

North Carolina is not alone in ignoring the full health effects of ground-level ozone. The Federal Clean Air Act (CAA) sets a clear standard for the EPA in its efforts to evaluate the health effects of new regulations. In setting emission standards, the EPA must submit a "Criteria Document" that evaluates "all identifiable effects on public health or welfare which may be expected from the presence of such pollutants in the ambient air."[22] But in setting its criteria, the EPA not only presented no quantitative analysis of the UV-B effects of ozone but, in its official Criteria Document, it did not even mention these effects. In other words, when considering the health impacts of its proposed standard, the EPA looked only at the benefits and ignored the costs. In doing so it insured the conclusion that the new standard would be justified.

III. Advocacy Science and Media Complacency

A. The ALA's State of the Air Report

Every year several different environmental advocacy groups issue reports which claim to be documenting the ozone problem facing the United States. Typical of these is the American Lung Association's study titled "The State of the Air"[23] released each May.[24] In this study, the ALA reports on ozone pollution over the previous three-year period on a county-by-county basis. As part of this study, each county is given a grade (A-F) based on the number of ozone-exceedence days it experiences. In addition, the study calculates a number that it claims shows how many people were at risk for respiratory problems as a result of these exceedances.

This report receives a great deal of media attention and, particularly at the state level, has a significant impact on policy debates. Local media outlets are quick to notice the report because it issues grades on a county-by-county basis and uses its results to rank states and counties based on air quality.

Every aspect of the annual ALA report is methodologically flawed. Its reporting of ozone data and extent of detrimental health effects in local communities is misleading, and its grading system and rankings are meaningless. Also, the ALA report is based on "old" data. For example, its most recent study released in May 2002 was misleadingly titled *The State of the Air 2002,* when in fact it focused on data for a three-year period between 1998 and 2000 (data for 2001 had been available since the previous October). Since ozone levels depend a great deal on weather conditions that exist at a particular time, what occurred between 1998 and 2000 is irrelevant to the "state of the air" in 2002, or even 2001 (see Appendix for North Carolina ozone data, 1993-2001).

As was noted, the way in which ozone statistics are officially reported for any geographic area is misleading, and because of this, any analyst must be careful in how data is used and what implications are drawn from it. To reiterate, in reporting data from a county, a region, or a state, the EPA and other government agencies will count an ozone exceedence from any one monitor against the entire geographical area. For example, assume that a county has four ozone monitors at different locations. If only one of those monitors shows an exceedence for a given day, while the other three record below-exceedence levels of ozone, the entire county will be reported as being out of compliance. The implication is that the county will always be reported as having considerably more ozone exceedence days in a given year than any location in the county actually experiences (see example from the Triad area of North Carolina cited on page 4).

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The ALA study adopts this methodology in its annual report and consequently presents a distorted picture of the true number of ozone-exceedence days. A typical example is Wake County, North Carolina. The 2002 ALA study reported that during the 1998-2000 period, the county had a total of 74 ozone-exceedence days.[25] But the fact is that no single location in the county experienced anything like this number. In reality the average number of exceedence days registered in locations with ozone monitors was only about 21 for the three-year period. The fact is that the ALA's method of reporting ozone is completely biased against counties or states with more monitors. The greater the number of monitors in any given area, the more likely it is that that area will show an exceedence on any given day. Because the ALA study doesn't adjust for the number of monitors, it is useless as a measure of the actual number of high ozone levels being faced by individual communities and as a tool for comparing one county, city, or state to another. Yet, these kinds of comparisons are an important part of the ALA study.

In adopting this reporting method, the ALA study also ends up exaggerating its estimates of the number of people who are at risk from ozone pollution. First, the study defines the ozone "sensitive" group as being all people, regardless of age, with asthma, bronchitis, or emphysema; all children under the age of 14; and all adults over the age of 65. Furthermore, they assume all of these groups are put at risk whenever the 80 ppb standard is exceeded. As discussed above, these assumptions are problematic and were noted as such by CASAC. Beyond this though, whenever the study cites a county as having an ozone-exceedance day, even if only one monitor in one location in the county is out of compliance, the entire population of the county that the study has defined as "sensitive" is reported as being at risk.

In 1998 a monitor located in rural Fuquay-Varina registered four exceedance days that were not registered in any other location. The entire "sensitive" population of Wake County including Raleigh was listed as "at risk" in the ALA study.

Once again, Wake County, North Carolina presents an excellent example. In 1998 a monitor located in Fuquay-Varina, one of the county's most rural and least-populated communities, registered four exceedance days that were not registered on monitors in any other location. In spite of this, the entire "sensitive" population of the county, including the population of the city of Raleigh, which showed no exceedances on those days, was listed as "at risk" in the ALA study. So when the ALA states that "More than 30 million children under the age of 14—whose lungs are particularly vulnerable to the effects of ozone-filled air—are living in counties that received an "F" in air quality,"[26] the implication, that 30 million children are being exposed to dangerous levels of ozone is, at best, irresponsibly misleading.

Apparently this is a problem that is not controlled for in many of the studies examining the relationship between ozone and asthma. As a survey of the literature appearing in the journal *Inhalation Toxicology* concludes, "another problem with the exposure data is that in some studies, the air quality monitoring stations were far removed from large segments of the population, and therefore the data from these stations are not representative even of outdoor exposures of many of the subjects."[27]

It should also be noted that the ALA study misleadingly reports the same people as being at risk in several different categories. For example, it gives a total for both all children under 14 and children with asthma, even though the latter is a subset of the former. In stating the conclusion that "as many as 27.1 million children 13 and under, and over 1.9 million children with asthma are potentially exposed to unhealthful levels of ozone,"[28] the ALA is actually referring to many of the same children twice. Technically they avoid double counting only because they do not aggregate.

The ALA's A-to-F grading system is also useless in conveying any information regarding either the extent of the health-related problems that might be due to ozone levels, or relative air quality in a county-by-county comparison. A county is given a grade of F if there are three

monitor readings greater than or equal to 85 ppb averaged over an eight-hour period during the three years of analysis. This raises several problems. Imagine county A and county B where county A registers three mild-exceedance days over a period of three summers of 85 ppb, with no other days registering above 65 ppb. This county would be given an F by the ALA. Now imagine county B where there are 40 days measuring 84 ppb with no day registering below 75 ppb. The ALA grading system would give county B a grade of A because it had no exceedences over the three-year period. It is quite clear that these two grades would tell us nothing about the relative healthiness of the air in these two counties.

At this juncture it is important to recall CASAC's comments (cited previously). When considering the 70 to 90 ppb range that was being considered by the EPA, CASAC stated that "there is no 'bright line' which distinguishes any of the proposed standards (either the level or the number of allowable exceedances) as being significantly more protective of public health." In other words, in terms of health effects, in the example above where one county receives an A and the other receives an F, neither county would be "significantly more protective of public health." In this case, the difference between an A and an F in the ALA study would turn out to be, in terms of actual protection of public health, no difference at all.

Throughout its study the ALA consistently ignores CASAC's conclusions regarding ozone's health effects and writes as if the "bright line" that CASAC emphatically states does not exist, somehow does exist. Throughout the section of the study titled "Health Effects of Ozone," references are made to the consequences of exposure to "high" and "low" levels of ozone but, in fact, it gives no specific data concerning health effects that will occur when the exceedence threshold is crossed.[29] And while the ALA consistently refers to populations that are "at risk" due to crossing the threshold, nowhere in any of its studies do they make any attempt to examine the actual relationship between asthma problems and counties with many or few ozone exceedences. For example, if they had done this with regard to North Carolina, they would have found that the counties with the most ozone-exceedence days frequently tend to have the fewest hospital admissions for asthma attacks among children (see Appendix). This is the demographic that the ALA claims to be most at risk.

> *The Public Interest Research Group…misleadingly counts the same ozone-exceedence day many times over…for 2001 they claim that North Carolina had 182 high-ozone days, when in fact this amounted to an average of only 3.5 days per monitor.*

B. PIRG and Clear the Air: Lies, Damn Lies and Statistics

As noted, the ALA report is only one of several equally deceptive "studies" on the subject of ground-level ozone that are published each year by environmental advocacy groups. For example, each summer the Public Interest Research Group publishes a report giving ozone data on a state-by-state basis, in which they misleadingly count the same ozone-exceedence day many times over. For example, if on a particular day, three monitors in one city registers

an ozone exceedence , the entire state, in its study, is said to have three exceedence days. This is why its study will frequently show a state as having more high ozone days than there are days in a year. It also hyperbolizes the issue and scares the public. For example, in its 2001 study, PIRG claims that North Carolina had 182 high-ozone days, when in fact this amounted to an average of only 3.5 days per monitor with over 30 percent of all monitors registering no exceedences at all.[30]

A third advocacy group-based study has gotten a great deal of media attention and is now being used in North Carolina to form part of the basis for energy policy recommendations promoted by an energy policy tax force based at Appalachian State University.[31] It centers around the health effects of ground-level ozone. This study, titled *Out of Breath: Health Effects from Ozone in the Eastern United States*,[32] was commissioned by a coalition of advocacy groups called Clear the Air. It claims that in 1997, ground-level ozone caused 240,000 asthma attacks in North Carolina.

This study is typical of the kind of analysis that is published by advocacy groups and finds its way into the popular media. First of all, the study uses statistical methods to guess at the relationship between ozone and asthma, and it bases its analysis on only that part of the scientific literature that supports the conclusion that it wants to reach. There is no use of actual asthma attack data in this study. Indeed, there can't be, because data does not exist for North Carolina. This insures that no one can disprove the statistical guesses by appealing to the actual data.

The fact is that real data exists, relating childhood hospital admissions for asthma and ozone-exceedence days for 1997. Data not only shows there is no positive relationship between the two, but that there is a slight negative relationship. Contrary to the results in "Clear the Air," in 1997, Swain County, North Carolina, which had the highest rate of asthma hospital admissions for children, had no ozone-exceedence days. On the other hand, Caswell County had the highest number of ozone-exceedence days per monitor—17– but had the fewest number of childhood asthma hospitalizations per 100,000 in population.[33] For all years in which data are available, no positive correlation between these two data sets can be found. This actually suggests that ozone levels typically experienced in North Carolina, even on ozone-exceedence days, are not high enough to trigger severe asthma problems. This is consistent with CASAC's analysis of the national data discussed above.

The Clear the Air study claims that in 1997, ground-level ozone caused 240,000 asthma attacks in North Carolina. Real data relating childhood hospital admissions for asthma and ozone-exceedence days show that there is a slight negative relationship.

Typically, media outlets fail to take time to investigate the veracity of these publications and proceed to uncritically report their results. Because of this, the public's perceptions and, therefore, critical public policy issues, are being guided by what is most accurately referred to as junk science.

Conclusion

The issue of ground-level ozone has become an important weapon in the arsenal of many environmental advocacy groups and government agencies whose budgets and power rest in the promulgation of new regulations. The fact is that answers to questions regarding the health effects of ozone are not black and white. There is no dispute that ozone, when inhaled, can cause lung irritation, but there is not agreement concerning the minimum concentration levels at which these effects kick in. Furthermore, characterizing ozone in the upper atmosphere as "good" and the same gas at groundlevel as "bad," may further the image of regulators and advocates as wearing purely white hats, but it does not further true scientific understanding. As noted, in reality, when a new law like North Carolina's Clean Smokestacks bill is put in place, it may, if successful in reducing ozone, reduce asthma problems. On the other hand, it may also contribute to increased incidences of skin cancer. Politicians who are serious about improving public health overall would insist on a complete cost-benefit[34] analysis of such a policy before ever making up their minds about how to vote. Needless to say, no such analysis was ever requested.

The information mill on these issues tends to be controlled by those who have a personal stake in the outcome, with enlightened democracy as its main casualty.

As the environment becomes cleaner and cleaner, further attempts to "scrub" away all human impacts on our air, land and waterways become increasingly costly. Because of this, a well-informed electorate is more important than ever. Unfortunately, the information mill on these issues tends to be controlled by those who have a personal stake in the outcome, with enlightened democracy as its main casualty.

Notes

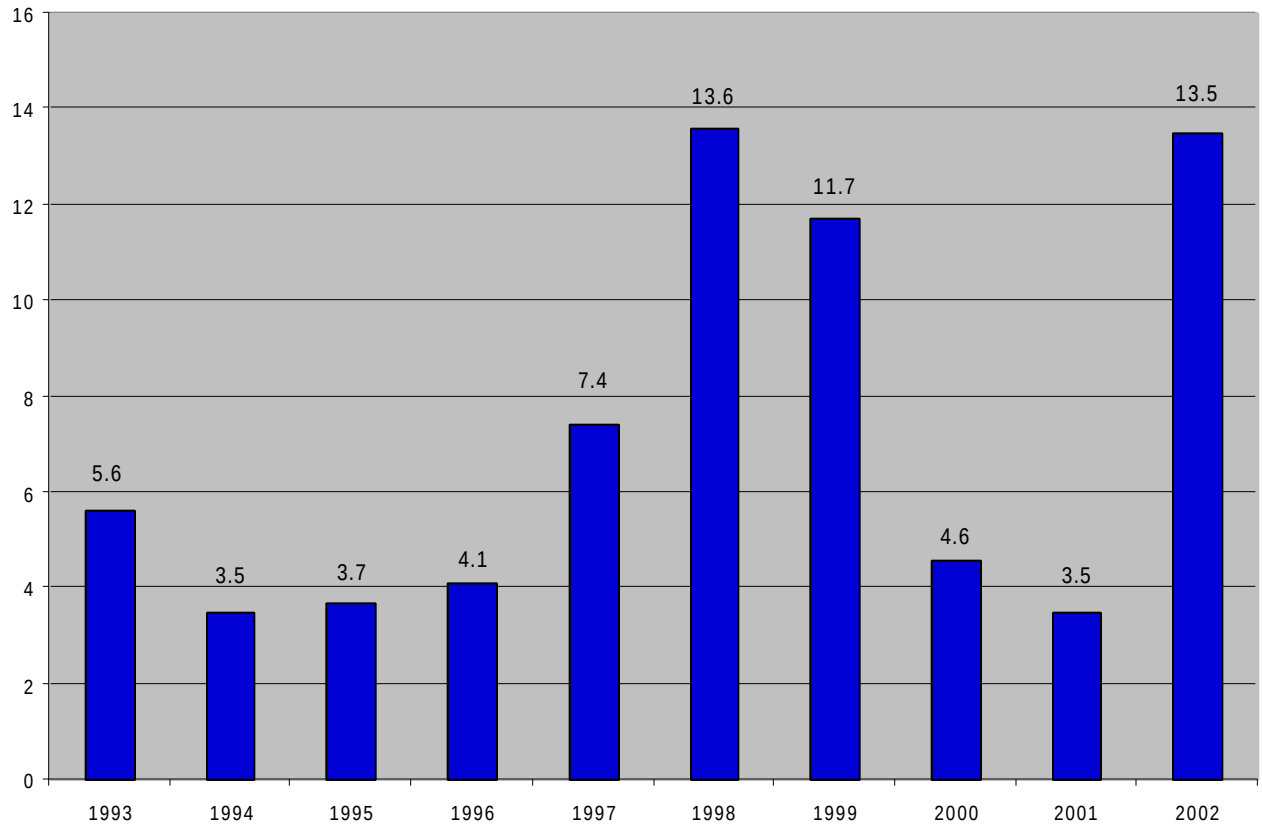
1. See *State of the Air 2001*, published by the American Lung Association, found at www.lungusa.org and *Danger in the Air: Unhealthy Smog Days in 2000*, published by The Clean Air Network and The U.S. Public Interest Group Education Fund, found at www.pirg.org.
2. *Up in Smoke: Congress' Failure to Control Emissions from Coal Power Plants*, published by U.S. PIRG Education Fund and Environmental Working Group, found at www.ewg.org, p.2.
3. "The Energy Working Group Draft Energy Plan," at www.ncenergy.appstate.edu.
4. "Smog in the Triad—2001 Update" Forsyth County Environmental Affairs Department, Vol. 4 Nov. 2001. Found at www.co.forsyth.nc.us/envaffairs/.
5. "Latest Findings on National Air Quality: 2000 Status and Trends" US EPA, Office of Air Quality, Sept. 2001, EPA 454/k-01-002, at www.epa.gov/airtrends.
6. "Latest Findings on National Air Quality: 2000 Status and Trends" US EPA, Office of Air Quality, Sept. 2001, EPA 454/k-01-002, at www.epa.gov/airtrends.
7. For a detailed discussion and analysis of these health effects see Susan E. Dudley, "Comments on the U.S. EPA's Proposed National Ambient Air Quality Standard for Ozone," published by George Mason University's Center for the Study of Public Choice Regulatory Analysis Program, March 12, 1997, pp. 1-23 to 1-33.
8. This discussion is based on a summary of the pulmonary health effects presented in Dudley, Ibid.
9. "National Ambient Air Quality Standards for Ozone; Final Rule," Part V, U.S. EPA, Federal Register, Vol. 62, No. 138, July 18, 1997, p. 38864.
10. Ibid.
11. Clean Air Act, section 109(d)(2)
12. Ibid., section 108(a)(2)
13. "CASAC Closure on the Primary Standard Portion of the Staff Paper for Ozone," Clean Air Scientific Advisory Committee, U.S. Environmental Protection Agency, EPA-SAB-CASAC-LTR-96-002, November 30, 1995.
14. Ibid.
15. "Ozone FAQs," North Carolina Department of Health and Human Services, Division of Public Health. Found at www.dhhs.state.nc.us/docs/ozonefaqs.htm.
16. See a coloring book published by the NC DAQ titled "Air Pollution A-Z" at http://daq.state.nc.us/airaware/edu/.
17. Randall Lutter and Christopher Wolz, "UV-B Screening by Tropospheric Ozone: Implications for the National Ambient Air Quality Standards" Environmental Science and Technology News, Vol. 31, No. 3, 1997, p.143.
18. Ibid.
19. U.S. Dept. of Energy, Office of Health and Environmental Research; remarks presented at March 21, 1995, public meeting of CASAC; U.S. EPA Science Advisory Board Public Meeting File; Washington, D.C. 1995; ECAO-CD-92-0746.
20. Op.cit. note 17, p. 142.
21. Op. Cit. at note 7, p. B-4.

22. Op. Cit. at note 11.
23. Found at www.lungusa.org.
24. The other most widely publicized study is published by The Public Interest Research Group (PIRG) and is titled "Danger in the Air" (See note 36). This study suffers from most of the same problems as the ALA study (see section B below).
25. Found at www.lungusa.org/air2001/states/s_nc.html.
26. Found at www.lungusa.org/air2001/intro.html#executive.
27. H. Daniel Roth, et. al., "Assessment of Recent Ozone Short-Term Epidemiologic Studies," *Inhalation Toxicology*, Vol. 13, 2001, p,16.
28. www.lungusa.org/air/children_factsheet99.html
29. Found at www.lungusa.org/air2001/ozone.html#elderly.
30. http://uspirg.org/reports/dangerintheair2002.pdf
31. Op. cit., at note 3.
32. "Out of Breath: Health Effects from Ozone in the Eastern United States," Clear the Air National Campaign Against Dirty Power, October, 1999.
33. Roy E. Cordato, "Check the Facts Next Time," *Spotlight* No. 226, The John Locke Foundation, Raleigh, NC, October 16, 2002.
34. In the academic literature this is referred to as "comparative risk" or "health-health" analysis where the positive health effects of regulations are weighed against the negative effects. For a discussion and example of this kind of analysis see Randall Lutter and John F. Morrall, "Health-Health Analysis: A New Way to Evaluate Health and Safety Regulation," *Journal of Risk and Uncertainty*, Vol. 8, 1994.

Appendix

The graph below shows 10 years of ozone data for North Carolina. Each bar measures the average number of ozone-exceedence days per monitor for all monitors in the state. This gives a sense of how many ozone-exceedence days were experienced on average in any given location during each of the 10 years. It is clear from data that no consistent trend either upward or downward can be established. Years for which exceedence days "spiked," (1998, 1999, and 2002) are all associated with extraordinarily hot summers and not increases in emissions. All data were obtained from the North Carolina Department of Environment and Natural Resources, Division of Air Quality. Data for 2002 is preliminary and subject to revision.

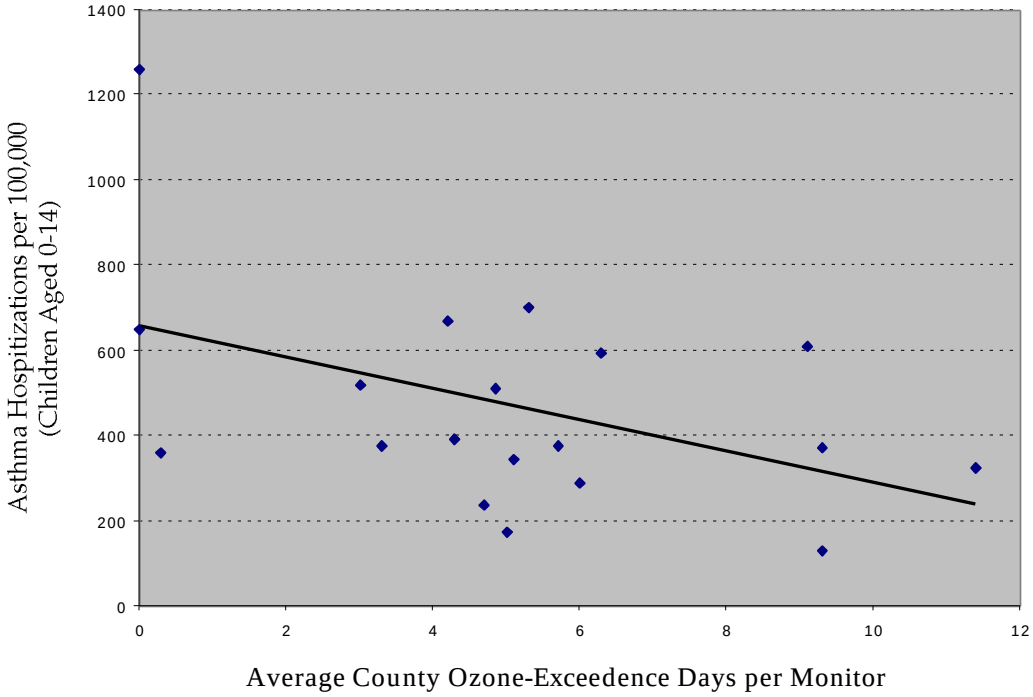
Average Number of Ozone-Exceedence Days per Monitor in North Carolina from 1993 to 2002



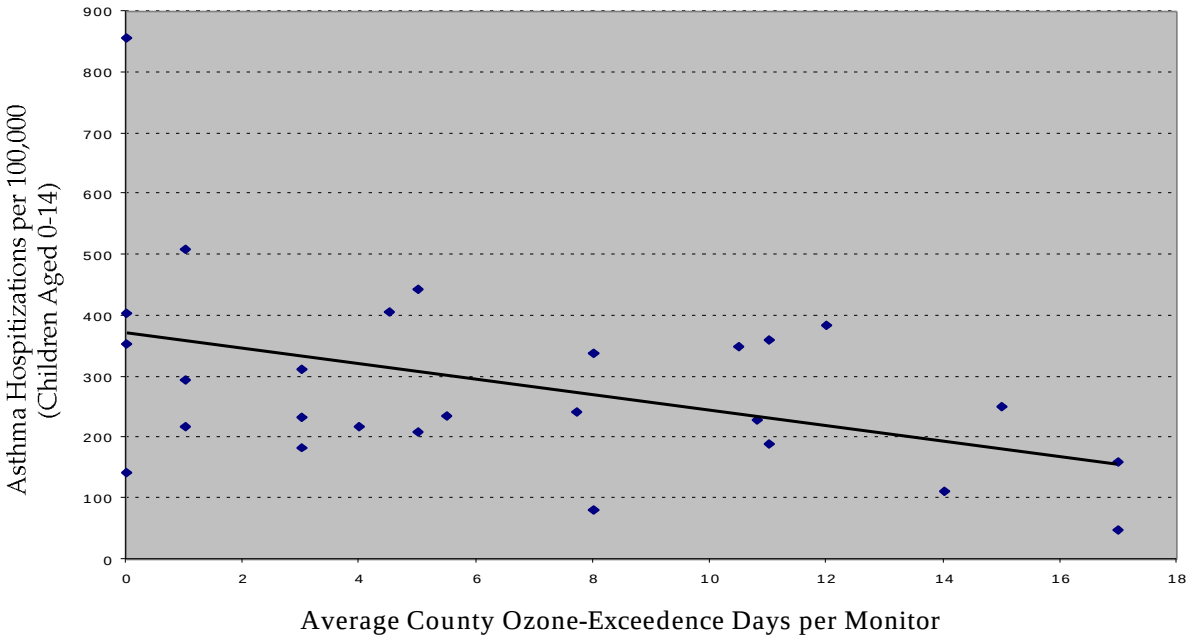
Source: North Carolina Dept. of Environment and Natural Resources

The Observed Relationship Between Asthma Hospitalizations for Children 14 and Under and the Average Number of Ozone-Exceedence Days Per County

1995-1997

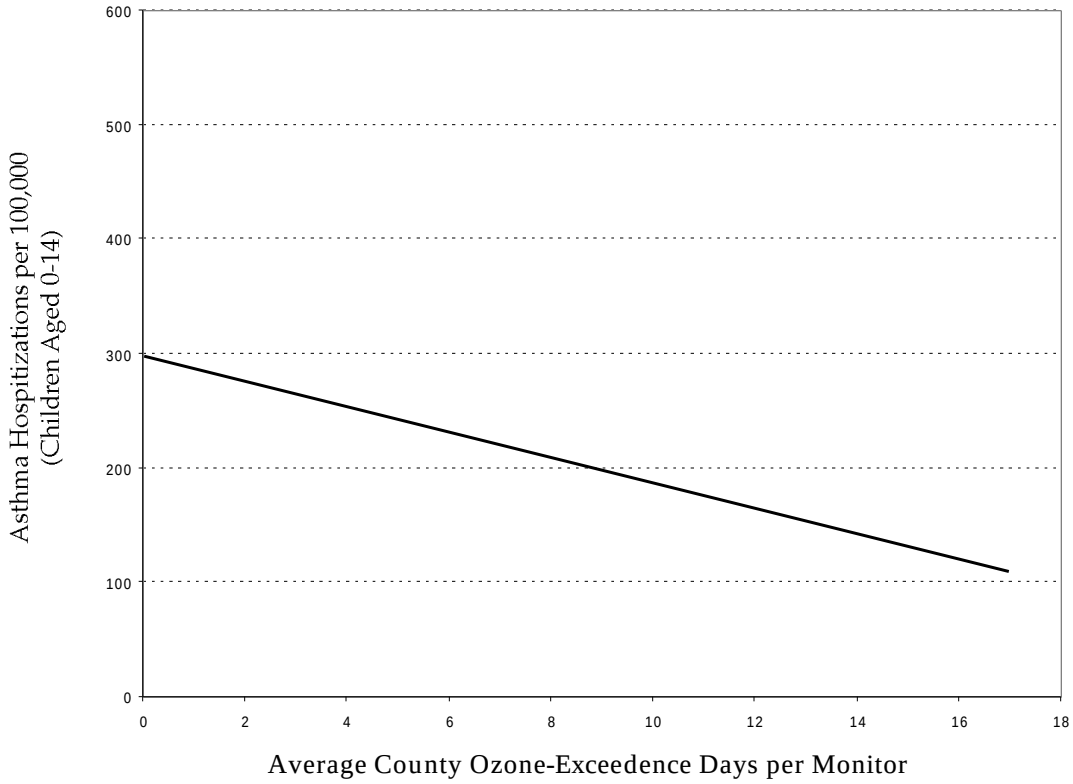


1997



The Observed Relationship Between Asthma Hospitalizations for Children 14 and Under and the Average Number of Ozone-Exceedence Days Per County

2000



The graphs above include all years and counties where overlapping ozone and and childhood asthma hospitalization data are available.

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