Clearing the Air in North Carolina

Pollution Myths and Realities

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Just as North Carolina was on the verge of full compliance with EPA's original ozone air pollution requirements, the standards were changed. In April 2004, most of the state once again was out of compliance. Policymakers and business leaders worry whether the state can meet the new federal requirements and avoid imposed limits on economic development and loss of federal transportation funds.

The new ozone standard is the only remaining air pollution challenge facing North Carolina, which meets EPA's standards for carbon monoxide, sulfur dioxide, nitrogen oxides, and "coarse" airborne particulates (PM10). Ninety-five percent of pollution monitors comply with EPA's fine particulate (PM2.5) standards and original ozone standard. The few monitors that exceed those standards do so by small margins. In spite of the facts, environmental activists claim the state has a serious air pollution problem. But these claims are misleading exaggerations. For example, the American Lung Association gave failing air quality grades to 12 of 18 monitoring locations that comply with EPA's new ozone standard.

To reduce ozone many are hawking measures to reduce driving and "command-and-control" regulations on industrial emissions. But these traditional approaches are inefficient, often focusing on measures with high costs and low benefits. In reality, air pollution has been solved as a long-term problem by already-adopted measures that will eliminate most remaining pollution from automobiles and industry in coming years. These requirements will achieve such large pollution reductions that population and transportation growth will have little effect on future air quality improvements.

North Carolina can speed progress toward attainment of the new ozone standard by adopting pollution control measures that deliver greater emission reductions more rapidly at lower costs than most current proposals. Perhaps the greatest untapped opportunity is "gross-polluting" automobiles. On-road pollution measurements in cities around the U.S. have shown that a small fraction of vehicles produces most vehicle pollution. The worst 5 percent of cars produce half of all ozone-forming volatile organic compound (VOC) emissions.

Gross polluters can be most efficiently identified with remote sensing, an inexpensive on-road pollution measurement technology, as they drive on the road. Their owners can then be required to repair the vehicles or voluntarily scrap them for a cash incentive. An aggressive program could reduce automobile VOC emissions by 30 to 40 percent within a year or two. Unfortunately, regulators and activists instead promote measures such as transit that reduce almost no emissions, cost hundreds of times more per ton of pollution removed, micromanage people's lifestyle choices, and take many more years to come to fruition.

Introduction

Just as North Carolina was on the verge of full compliance with EPA's original ozone air pollution standard, EPA moved the goalposts in April 2004, placing most of the state once again out of compliance.[1] The new ozone standard had been in the works for several years, so it came as no surprise to policy insiders. However, it has caused much hand wringing among North Carolina's policymakers and business leaders, who worry whether the state can meet the new federal requirements and avoid sanctions such as limits on economic development and loss of federal transportation funds.[2]

The new ozone standard is the only remaining air pollution challenge facing North Carolina. All pollution monitors in the state meet EPA's standards for carbon monoxide, sulfur dioxide, nitrogen oxides, and "coarse" airborne particulates (PM10). All but a handful of monitors comply with EPA's fine particulate (PM2.5) standard and original ozone standard.[3] The few monitors that still exceed those standards do so by small margins.

To control ozone, regulators, planners, and activists are hawking the traditional menu of social engineering measures to reduce driving, and "command-and-control" regulations on industrial emissions. But the traditional approaches fail on two counts: First, they are inefficient, often focusing on measures with high costs and low benefits. Second, they are predicated on the assumption that existing requirements won't reduce emissions enough to attain the new ozone standard.[4]

In reality, air pollution has been mitigated as a long-term problem by already-adopted measures that will progressively eliminate most remaining pollution from motor vehicles and industry in coming years. These existing requirements will achieve such large pollution reductions that population and transportation growth will have little effect on future air quality improvements.

In the meantime, North Carolina can speed its progress toward attainment of the 8-hour ozone standard by reorienting policy toward pollution control measures that deliver greater emission reductions more rapidly and at lower costs than current business-as-usual approaches.

I. How Bad Is North Carolina's Air Pollution?

According to environmental activists, North Carolina has a serious air pollution problem. For example, the Public Interest Research Group (PIRG) asserts "North Carolina has some of the worst air pollution in the country."[5] The American Lung Association (ALA) recently ranked the Charlotte area 14th in the nation for ozone pollution. ALA gave 40 North Carolina counties a failing grade for ozone and seven a failing grade for fine particulates.[6] Activists have also claimed air pollution is increasing.[7]

Fortunately for North Carolina's residents, the activists' claims are misleading exaggerations of actual air pollution levels. Regardless of whether an area complies with even EPA's most stringent pollution standards, it's likely to get a failing grade from ALA. Figures 1, 2, and 3 display ozone and PM2.5 levels relative to federal standards in North Carolina counties. The letters along the top list the air quality grades ALA gave each county for the given pollutant.

Note that ALA's grades bear little relationship to actual air quality and fail many areas that have clean air based even on EPA's toughest standards. For example, ALA even gave a failing grade to 12 locations that comply with the 8-hour ozone standard, and gave only one county an A (see Figure 1).[8] Furthermore, all but three North Carolina monitoring locations comply with the 1-hour ozone standard, yet almost all got a failing grade from ALA.[9]

All of North Carolina complies with the 24-hour PM2.5 standard by a large margin, yet ALA gave an A to only a few counties and failed three (see Figure 2).[10] Although only two monitoring locations in all of North Carolina violate EPA's annual PM2.5 standard, ALA failed five counties and didn't even grade the two counties with the highest annual PM2.5 levels (see Figure 3).[11]

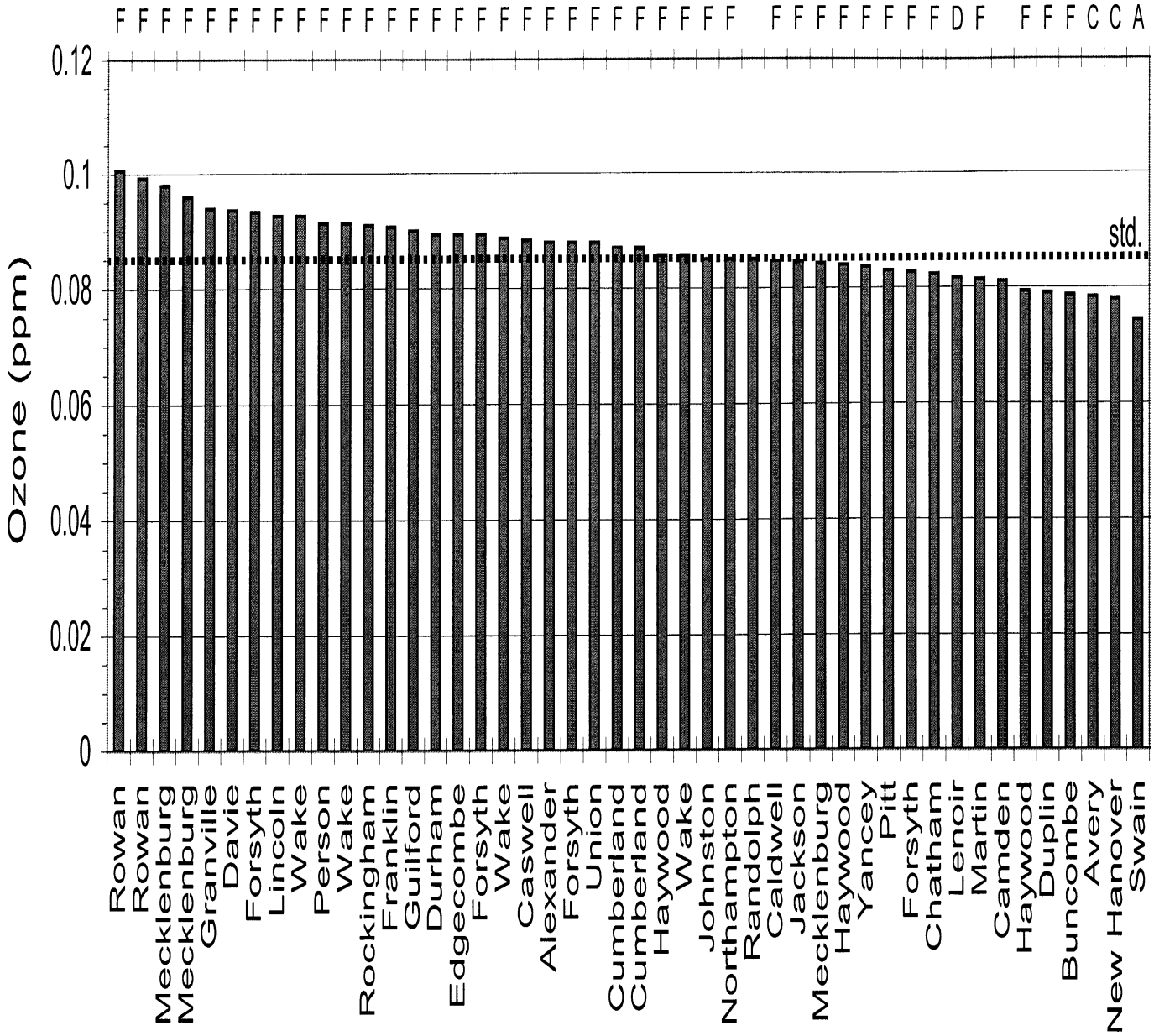
ALA used several techniques to create the impression of higher pollution than ever actually occurs. For example, ALA inflated the number of days per year that a given area exceeds EPA's ozone and PM standards, and used tougher ozone and PM standards than EPA when handing out grades. ALA also used data only through 2002 when giving out grades. But 2003 turned out to be a low-ozone year, and PM2.5 levels have been steadily dropping over time. Thus, when the most recent data is included, the result is lower pollution levels. Finally, pollution levels often vary from place to place within a county. Note, for example, in Figure 1 that one of Mecklenburg County's three ozone monitoring sites complies with the 8-hour ozone standard, while two sites violate the standard. Despite these local variations, ALA gives a failing grade to the entire county.

ALA's metropolitan pollution rankings are similarly designed more to alarm than to inform. For example, Charlotte's ozone rank of 14th in the nation seems pretty scary. But ALA fails to mention that once you get past the worst seven counties in the country, ozone levels are relatively low, as shown in Figure 4.

The graph plots the average number of days per year that the worst location in a given county exceeded the 8-hour and 1-hour ozone standards during 2001-2003.[12] The graph includes the worst eight counties in California, which are also the worst in the U.S., some of the worst counties in a few other states, and a representative selection of North Carolina counties, including several of the worst. Numbers along the top give each county's rank out of 713 counties with monitoring data.

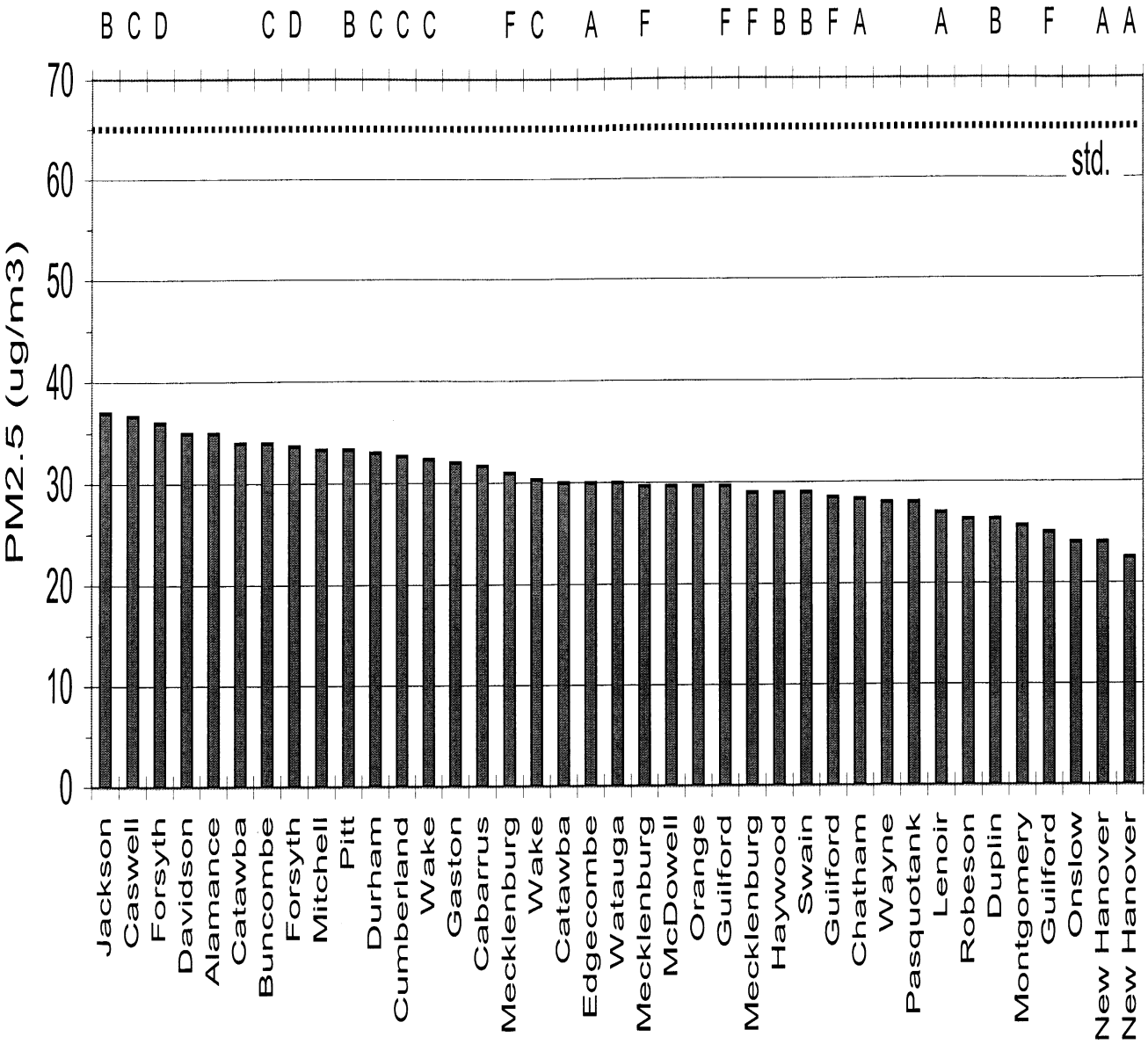
Note that outside California few counties ever exceed the 1-hour ozone standard, and those that do typically have no more than one to three exceedances per year. Even 8-hour exceedances, which occur at much lower ozone levels than for the 1-hour standard, are relatively infrequent at these non-California locations. Figure 4 also belies PIRG's claim that North

Figure 1. Ozone Levels Relative to EPA's 8-hour Ozone Standard and ALA Air Quality Grades.



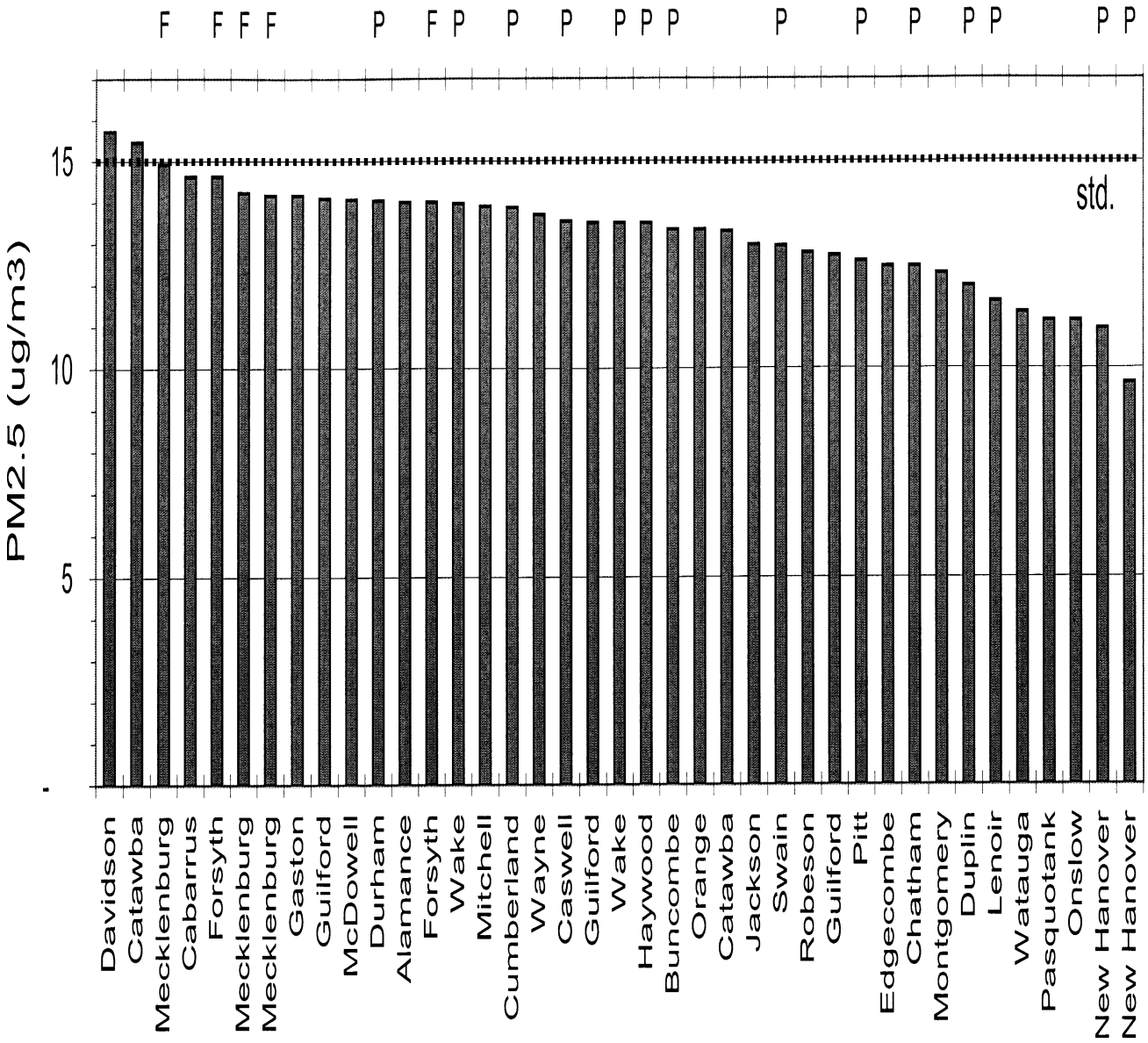
Notes: Each bar represents an individual monitoring site. Labels along the bottom give the county in which the monitoring site is located. Some counties have more than one monitoring site and therefore appear more than once in the chart. The dotted horizontal line marks the 8-hour ozone standard. Letters along the top give ALA's grade for the county in which a given monitoring site is located (or a blank for counties that ALA did not grade). Compliance with the 8-hour ozone standard is based on data for 2001-2003.

Figure 2. 24-hour PM2. 5 Levels Relative to EPA's Standard and ALA Air Quality Grades.



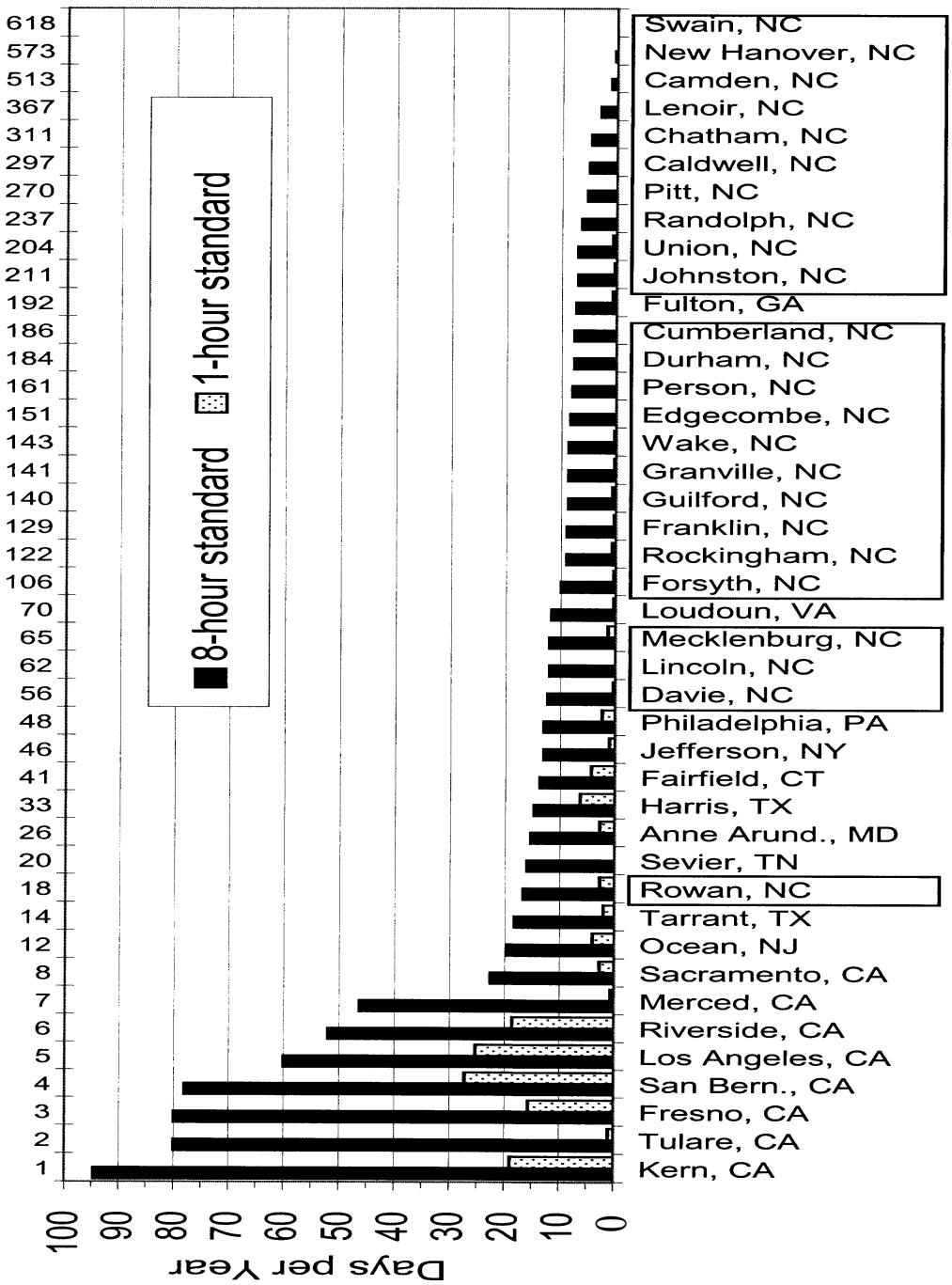
Notes: Each bar represents an individual monitoring site. Labels along the bottom give the county in which the monitoring site is located. Some counties have more than one monitoring site and therefore appear more than once in the chart. The dotted horizontal line marks the 24-hour PM2.5 standard. Letters along the top give ALA's grade for the county in which a given monitoring site is located (or a blank for counties that ALA did not grade). The plotted values are based on the average of the 98th percentile of daily readings for 2001-2003, which is how compliance with the standard is determined.

Figure 3. Annual PM2. 5 Levels Relative to EPA's Standard and ALA Air Quality Grades.



Notes: Each bar represents an individual monitoring site. Labels along the bottom give the county in which the monitoring site is located. Some counties have more than one monitoring site and therefore appear more than once in the chart. The dotted horizontal line marks the annual PM2.5 standard. Letters along the top give ALA's grade for the county in which a given monitoring site is located (or a blank for counties that ALA did not grade). ALA gave out pass/fail grades rather than letter grades for annual PM2.5 levels. Compliance with the annual PM2.5 standard is based on data for 2001-2003.

Figure 4. Days per Year Exceeding the 8-hour and 1-hour Ozone Standards at the Worst Location in a Given County. Average for 2001-2003.



Notes: Numbers along top give county's rank among 713 counties with ozone monitoring data. Ranking is based on 8-hour ozone exceedances.

Carolina has "some of the worst air pollution in the country." No area of North Carolina even comes close to earning this ignominious title.

And rather than increasing, air pollution has generally declined. PM2.5 levels have declined 35 to 40 percent since the early 1980s, and more than 15 percent in just the last four years, bringing the state to the verge of full PM2.5 attainment.[13] The record on ozone is more mixed. One-hour ozone exceedances have generally declined modestly and 94 percent of monitoring locations comply with the standard. In contrast, 8-hour ozone exceedances have showed no significant trends in either direction. Furthermore, the number of ozone exceedances varies substantially from year to year due to weather; all else equal, warm, dry years have higher ozone levels than cool, rainy ones. On a positive note, 2003 was one of the lowest ozone years on record. Also noteworthy is that North Carolina has improved or at least held the line on air pollution in the face of rapid population growth.

North Carolina has much less of an air pollution problem than the public has been led to believe. Except for the 8-hour ozone standard, almost the entire state complies with all other pollution standards, and the few areas that exceed the 1-hour ozone and annual PM2.5 standards do so by small margins. Even so, does exceeding the 8-hour standard pose a significant threat to people's health?

The answer appears to be no. Back in 1996 EPA predicted that going from full attainment of the 1-hour ozone standard to full attainment of the 8-hour standard would reduce hospitalizations from asthma attacks by 0.6 percent.[14] In other words, at current levels, ozone is having at worst a tiny effect on public health. Indeed, as shown in Figure 5, asthma hospitalization rates in North Carolina are actually higher in counties that have lower ozone levels. Nevertheless, just as it exaggerates air pollution levels, ALA exaggerates health effects. Although air pollution at current levels accounts for less than 1 percent of all respiratory and cardiovascular distress, ALA claims that fully two-thirds of North Carolina's people are "at risk" from current air pollution levels.[15]

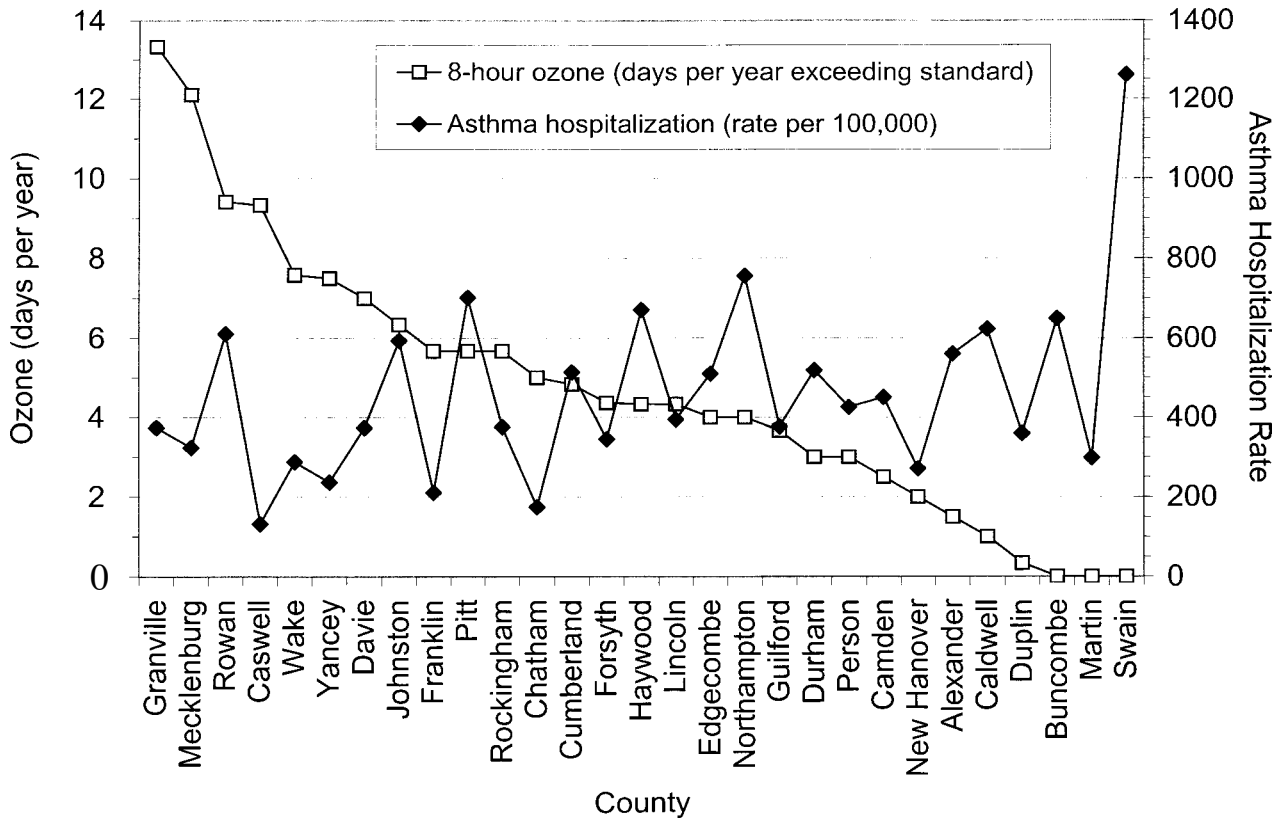
II. Improving Air Quality

Regardless of whether the 8-hour ozone standard is a foolish policy, North Carolina still has to attain it. What is the least painful way to get there? Policymakers should consider two factors that I discuss in more detail below:

• Though it will likely come as a surprise to most people, existing requirements will eliminate most remaining air pollution during the next 20 years, even if North Carolina enacts no additional regulations. Policymakers' choices can affect when the standard is attained and how much it costs to get there, but the long-term problem has already been solved.

• The Clean Air Act, EPA's associated policies and regulations, and activists' pet policy prescriptions discourage sound strategies for attaining pollution standards, both in terms of costs

Figure 5. Asthma Hospitalization Rates for Children Aged 0-14 vs. 8-hour Ozone Exceedance Days per Year in North Carolina Counties, 1995-97



Notes: Number of 8-hour ozone exceedances per year is the average for all monitoring sites in a county during 1995-97. Asthma data are from P. Buescher and K. Jones-Vessey, Childhood Asthma in North Carolina (Raleigh: North Carolina State Center for Health Statistics, March 1999), www.schs.state.nc.us/SCHS/pdf/schs113.pdf.

and effectiveness. Regulatory costs are ultimately paid by consumers in the form of higher prices for useful goods and services. Policymakers could substantially reduce the costs of attaining the 8-hour ozone standard by refocusing regulatory efforts toward measures that deliver the most pollution reduction per dollar invested.

Roughly three-quarters of pollution emissions in North Carolina's metro areas comes from motor vehicles, much of it from automobiles.[16] But data collected on the road and in vehicle inspection programs show that the emissions of the average automobile are dropping about 10 percent per year, as the fleet turns over to more-recent models that start out and stay cleaner than earlier ones.[17] These declines will continue; a fleet of automobiles meeting EPA standards that phase in starting this year will emit at least 90 percent less pollution per mile than the average vehicle currently on the road.[18]

Suburban growth and the popularity of SUVs will at worst have a minor effect on these future declines. While the average car's emissions are dropping 10 percent per year, driving is increasing by at most 3 or 4 percent per year in the fastest-growing areas and more slowly elsewhere, meaning total automobile emissions are declining at least 6 or 7 percent per year. The difference in emissions between cars and SUVs or pickup trucks disappeared with the 1996 model year for volatile organic compounds (VOCs) and the 2001 model year for oxides of nitrogen (NOx). VOCs and NOx are the two pollutants that help form ozone. EPA's 2004 standards require SUVs and pickups to meet the same tough emissions and durability requirements as cars.[19] Thus, going forward, the popularity of larger vehicles will make no difference for air quality.

Likewise, EPA regulations for heavy-duty diesel trucks and off-road equipment require a 90 percent reduction in nitrogen oxides and soot emissions starting, respectively, in 2007 and 2010.[20] These requirements are in addition to progressively more stringent emissions requirements already implemented during the last several years for these vehicles.[21]

Industrial emissions will also decline. Power plants are the largest industrial pollution source, yet EPA's NOx "SIP Call" regulation is being implemented this year and requires a 60 percent reduction in NOx emissions from power plants and industrial boilers during the May-to-September "ozone season."[22]

The Clean Air Act's acid rain program is similarly reducing PM-forming sulfur dioxide emissions from power plants, including an already-achieved 30 percent reduction from 1995-2000, and another 20 percent reduction from 2000-2010.[23] North Carolina is on the verge of full attainment of EPA's PM2.5 standards, and PM2.5 declines will continue. EPA has over the last few years also required reductions of 60 to 99 percent in a range of hazardous air pollutants from dozens of industries.[24]

If air pollution has been solved as a long-term problem, the question then becomes how to get cleaner air sooner. Perhaps the greatest untapped opportunity is "gross-polluting" automobiles. For more than a decade, on-road pollution measurements in cities around the U.S. have shown that a small fraction of vehicles produces most vehicle pollution.[25] Recent measure-

ments using a technology called remote sensing have shown that the worst 5 percent of cars produce about half of all automobile VOC emissions - a major contributor to ozone.[26]

Gross polluters continue to be found on the road despite the existence of vehicle inspection programs, which have been shown in numerous studies over the last 15 years to be ineffective due to fraud and motorist avoidance.[27] Scheduled vehicle inspections are analogous to trying to stop drunk driving through scheduled annual sobriety checks. Instead, gross polluters can be identified with remote sensing as they drive on the road and their owners are required to repair the vehicles or voluntarily scrap them for a cash incentive. An aggressive program could reduce automobile pollution by 30 to 40 percent within a year or two, but regulators and activists instead promote programs that do little to reduce emissions, cost hundreds of times more, and/or take many more years to come to fruition.

One example is transit. Metro areas around North Carolina plan to spend billions of dollars over the next 20 years to build and operate light-rail transit systems.[28] Yet even the agencies promoting these systems estimate that they will reduce air pollution by only about 1 percent compared to business as usual.[29] Even taking project-proponents' own cost and emission-reduction estimates for rail in North Carolina cities, light rail will cost millions of dollars per ton of ozone-forming pollution eliminated, or hundreds to thousands of times more than almost any other air pollution reduction measure ever considered.[30]

Other social engineering measures, for example, increasing residential density, would be similarly ineffective. Doubling residential density reduces per capita driving by less than 10 percent.[31] Even if this were practically and politically feasible, it would take many years, by which time most current vehicle emissions would have been eliminated by fleet turnover anyway. In the meantime, by focusing on gross polluters, even more pollution could be eliminated right now without micromanaging people's lifestyle choices.

In addition, increasing density actually increases road congestion by packing slightly less driving into much less land area. For example, if residential density is doubled, and per capita driving declines 10 percent, the amount of driving per unit of land area would increase by 80 percent.[32] With a doubling of density, per-capita driving would have to decline 50 percent just to keep congestion constant.

Of course there are many other ways North Carolina could get more bang for its air pollution reduction buck. Industrial pollution regulations and requirements such as New Source Review and Best Available Control Technology[33] discourage investment in new equipment and effectively require money to be spent on the least cost effective pollution reduction opportunities. The Clean Air Act's transportation conformity provision[34] requires that cities' mobility concerns take a back seat to air quality, even though motor vehicle air pollution is being solved by technology, and road congestion is a serious problem in many areas. Fixing these and other counterproductive policies will require politically difficult changes to federal law and regulation. However, there's no reason why state policymakers can't focus on gross polluters right now and back off on foolish and costly alternatives. The result will be cleaner air at a lower price.

Notes

1. B. Henderson, "Region slapped for air quality; EPA citation may limit industry, road projects, *Charlotte Observer*, April 16, 2004, p. 1A, R. Stradling, "Ozone limits spread; In urban areas, small towns added," Raleigh *News and Observer*, April 16, 2004, p. A1.

2. Ibid.

3. PM2.5 refers to airborne particulate matter up to 2.5 microns in diameter; PM10 is PM up to 10 microns in diameter. The original ozone standard was issued in 1979 and requires that a given monitoring location have no more than one day per year with peak ozone equal to or greater than 0.125 parts per million. Ozone is measured based on the highest 1-hour average level on each day, and the standard is therefore known as the "1-hour ozone standard."

4. The new ozone standard is based on the highest 8-hour average ozone level on each day and is therefore known as the 8-hour standard. The test for attaining the standard is more complex than for the 1-hour standard and works as follows: take the fourth highest daily ozone reading from each of the last three years and average those three readings. A location attains the 8-hour standard if the resulting value is less than 0.085 parts per million.

5. G. A. Owens, "Power Plants Do Count," Raleigh *News and Observer*, September 8, 2001 p. A19.

6. American Lung Association, *The State of the Air, 2004* (Washington, DC: May 1, 2004).

7. See, for example, NCair, www.ibiblio.org/ncair ("Air pollution is increasing in all areas of North Carolina, both urban and rural"); League of Conservation Voters, www.lcv.org/campaigns/campaigns.cfm?ID=1544&c=1 ("Air pollution is increasing in the [Charlotte region]").

8. Compliance with the 8-hour standard is as of the end of 2003.

9. Of the three sites that violate the 1-hour standard, two are in Rowan County and one is in Mecklenburg County. Both counties are in the Charlotte metropolitan region.

10. The 24-hour PM2.5 standard requires that the average of the 98th percentile daily value from each of the last three years be less than or equal to 65 micrograms per cubic meter (ug/m3). This means roughly that the 7th highest day of each year must be less than 65 ug/m3.

11. The annual PM2.5 standard requires that the annual-average PM2.5 level for the last three years be less than or equal to 15 ug/m3.

12. An "exceedance" of a given pollution standard occurs if pollution on a given day is at or above that standard. Thus, if a given location exceeded the 1-hour ozone standard, say, two times in 2003, that means there were two days during that year in which the peak 1-hour-average ozone level was at least 0.125 parts per million.

13. The recent decline is based on data from 1999-2003 collected at more than 30 locations around North Carolina. The long-term decline is based on a comparison of PM2.5 measurements collected in Mecklenburg, Wake, and Durham counties from 1979-84 in the Inhalable Particulate Monitoring Network (IPMN) with the more recent PM2.5 measurements in those same counties instituted since 1999 as part of EPA's new PM2.5 standards.

14. Environmental Protection Agency, "National Ambient Air Quality Standards for Ozone: Proposed Decision," *Federal Register*, December 13, p. 65715-65750, www.epa.gov/fedrgstr/EPA-AIR/1996/December/Day-13/pr-23901.txt.html.

15. American Lung Association, *The State of the Air, 2004.*

16. The key ozone-forming emissions are oxides of nitrogen (NOx) and volatile organic compounds (VOC). According to EPA's 1999 emissions inventory, in North Carolina's major metro areas, roughly 80 percent of NOx emissions come from motor vehicles and 20 to 30 percent comes from automobiles in particular. For VOC emissions, the official 1999 inventory has about 40 to 50 percent coming from motor vehicles, mainly gasoline vehicles. However, numerous studies have shown that EPA's official VOC inventories greatly underestimate the gasoline-vehicle contribution. In reality, gasoline vehicles probably contribute more like two-thirds to three-quarters of man-made VOCs in North Carolina. See, for example, J. G. Watson et al., "Review of Volatile Organic Compound Source Apportionment by Chemical Mass Balance," *Atmospheric Environment*, vol. 32 (2001), pp. 1567-1584.

17. J. Schwartz, *No Way Back: Why Air Pollution Will Continue to Decline* (Washington, DC: American Enterprise Institute, July 2003), www.aei.org/docLib/20030804_4.pdf.

18. Ibid.

19. Schwartz, *No Way Back*, Environmental Protection Agency, "Control of Air Pollution from New Motor Vehicles: Tier 2 Motor Vehicle Emissions Standards and Gasoline Sulfur Control Requirements; Final Rule," *Federal Register*, February 10, p. 6698-6870, www.epa.gov/otaq/tr2home.htm#preamble.

20. EPA, *Regulatory Impact Analysis: Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements* (Washington, DC: December 2000), EPA, *Regulatory Impact Analysis: Control of Emissions from Nonroad Diesel Engines* (Washington, DC: April 2004),www.epa.gov/otaq/diesel.htm.

21. Ibid.

22. EPA, *Addendum to the Regulatory Impact Analysis for the NOx SIP Call, FIP, and Section 126 Petitions* (Washington, DC: September 1998).

23. EPA, EPA's Acid Rain Program: Results of Phase I, Outlook for Phase II (Washington, DC: October 2001), www.epa.gov/airmarkt/articles/phase2factsheet.pdf.

24. See the specific rules at www.epa.gov/ttn/atw/mactfnlalph.html.

25. Among dozens of studies showing this, see for example, D. R. Lawson et al., "Emissions from in-Use Motor Vehicles in Los Angeles: A Pilot Study of Remote Sensing and the Inspection and Maintenance Program," *Air & Waste Management Association*, vol. 40, no. 8 (1990), pp. 1096-1105, Y. Zhang et al., "On-Road Hydrocarbon Remote Sensing in the Denver Area," *Environmental Science & Technology,* vol. 27, no. #9 (1993), pp. 1885-1891, S. S. Pokharel et al., *On-Road Remote Sensing of Automobile Emissions in the Chicago Area: Year 3* University of Denver and Coordinating Research Council, April 2000).

26. Schwartz, *No Way Back.*

27. See, for example, D. R. Lawson, "Passing the Test - Human Behavior and California's Smog Check Program," *Air & Waste*, vol. 43, no. December (1993), pp. 1567-1575, D. R. Lawson, "The Costs of "M" in I/M - Reflections on Inspection/Maintenance Programs," *Journal of the Air & Waste Management Association*, vol. 45 (1995), pp. 465-476, J. Schwartz, *An Analysis of the USEPA's 50-Percent Discount for Decentralized I/M*

Programs (California Inspection and Maintenance Review Committee, February 24, 1995), National Research Council, *Evaluating Vehicle Emissions Inspection and Maintenance Programs* (Washington, DC: National Academy Press, 2001).

28. R. Rubin and D. Whitacre, "1st Light-Rail Trains Ordered," *Charlotte Observer*, March 23, 2004, p. 1B.

29. See, for example, J. McLelland and B. Norowzi, "Air Quality Benefits of Infill Development-Charlotte, NC" (Charlotte, NC: Charlotte Department of Transportation, October 2, 2003).

30. Scrap programs that target cars based only on age have an estimated cost effectiveness of about $5,000 per ton of pollution eliminated. Targeting based on high emissions would substantially improve cost effectiveness. Likewise, repairing gross polluters identified with remote sensing has similarly attractive cost effectiveness. Eastern Research Group, *Overview of Voluntary Vehicle Scrap Programs for Reducing in-Use Vehicle Emissions* (Austin: June 2002), D. R. Lawson et al., *Program for the Use of Remote Sensing Devices to Detect High-Emitting Vehicles, Prepared for the South Coast Air Quality Management District* (Reno: Desert Research Institute, 1996, April 16 1996).

    The cost effectiveness of light rail for pollution reduction can be calculated from data in the Federal Transit Administration's (FTA) "New Starts" reports by dividing projected annual emission reductions of ozone precursor pollutants (i.e., VOC and NOx) by the projected annualized capital and operating costs of the rail project. Data for each project can be downloaded from www.fta.dot.gov/library/policy/ns/annreports.htm. I assumed a 7% interest rate and a 40-year amortization in calculating the annualized cost of rail projects proposed for Charlotte and Triangle. Based on the cost and pollution reduction estimates in FTA's fiscal-year 2005 New Starts report (www.fta.dot.gov/library/policy/ns/ns2005/nscover.html), the Charlotte South Corridor Light Rail line will reduce ozone-forming pollution at a cost of about $12.5 million per ton, while the Triangle regional rail system comes in at $2.4 million per ton.

31. C. L. Ross and A. E. Dunning, *Land Use Transportation Interaction: An Examination of the 1995 NPTS Data, Prepared for the Department of Transportation* (Atlanta: Georgia Institute of Technology, October 1997), http://npts.ornl.gov/npts/1995/Doc/landuse3.pdf.

32. Calculate this as follows: If residential density is doubled, a given number of people now live in half the amount of land. Assume per-capita driving declines 10%. Then the amount of driving per unit of land area is 0.9/0.5 = 1.8, or an 80% increase from the initial level.

33. New Source Review (NSR) is the regulatory program for new and modified industrial pollution sources. Best Available Control Technology (BACT) is one of the requirements for facilities undergoing NSR. NSR is counterproductive, because it makes new and upgraded facilities artificially more expensive than existing ones. As a result, NSR has encouraged companies to continue operating older plants well beyond their nominal useful lives. The BACT requirement often forces facilities to implement pollution reduction technologies that achieve few reductions at high cost, even though far cheaper and larger pollution reduction opportunities exist elsewhere. For detailed discussions of NSR, BACT, and better alternatives, see, for example, H. K. Gruenspect and R. N. Stavins, "New Source Review under the Clean Air Act: Ripe for Reform," *Resources* (Spring 2002), pp. 19-23, B. Swift, "Grandfathering, New Source Review, and NOx—Making Sense of a Flawed System," *Environment Reporter*, vol. 31, no. 29 (2000), pp. 1588-1596.

34. Transportation conformity is a Clean Air Act provision that requires metropolitan areas to ensure that building or expanding roads won't increase future vehicle emissions above some budgeted level specified in the region's air quality attainment plan. If a region can't demonstrate conformity, it can't spend federal highway funds. Conformity is based on the false premise that the best way to deal with pollution from driving is to restrict driving, rather than to deal with the small percentage of cars that produce most of the emissions.

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  Mr. Schwartz received his bachelor's degree in chemistry from Cornell University and his master's degree in planetary science from the California Institute of Technology. He lives and works in Sacramento, California.

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