Breathe Easier Now, Not Later

Technology alone cannot save humanity from pollution, certainly not in the time frame required. Yes, zero-polluting vehicles could be placed on the street now, and yes, every car in the world could be replaced if the collective will existed. But right now, it doesn't.

So, what else can be done in the absence of zero-polluting cars, trucks, and buses?

Plenty.

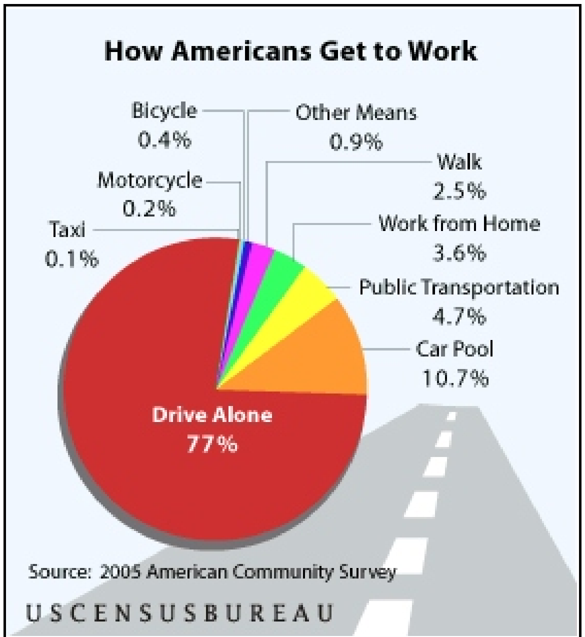

Figure 1

This discussion is partially about what an individual can do to reduce air pollution, but also about state and local actions that can be taken. In most cases, these can be implemented quickly, delivering fast benefits. Some, of course, take time, but a surprisingly large number of actions can provide, as the 1960s television advertisement for Alka Seltzer promised, "fast, fast relief."

The simple reality is that huge amounts of air pollution are due to solitary commuting and high speeds. The best solutions are to get people out of their cars and to drop the speed of every vehicle on the road. Everybody knows that Americans exceed the speed limit, and just obeying the law could make an immense difference.

Park Your Car

The cleanest car is one that's not being driven. Although some gasoline might boil off in the hot noon-day sun, modern cars capture those vapors. For all practical matters, a parked car is a zero-polluting car.

Gentlemen, Stop Your Engines

Sitting at a stop light or at the curb for more than 30 seconds wastes fuel and creates air pollution. Turn the engine off and restart it when it's time to move.

Slow Down

Because of wind resistance, as speed increases above about 45 miles per hour, fuel economy starts dropping and tailpipe pollution starts climbing. Slow down.

RED LIGHT, GREEN LIGHT

Stop lights and signs are mostly intended to keep traffic moving and increase safety. Most computer programs coordinate signals for speed and safety. But some focus on reducing air pollution. At least seven states—California, Florida, Washington, Minnesota, Maryland, Georgia and Texas—are finding ways to move traffic through intersections faster.[1]

Figure 2

PAY AS YOU GO

On February 17, 2003, London Mayor Ken Livingstone started a revolution—small, admittedly, but a revolution nonetheless. He imposed a charge for cars, trucks and other vehicles entering the most congested areas of the city, about 8 square miles. Between 7 a.m. and 6:30 p.m. vehicles in the "C" zone were automatically assessed a flat rate fee of £5 (about $9) per day, later raised to £8 (about $14.4), using about 700 different video cameras linked to an Automatic Number Plate Recognition (ANPR) computer system.[2]

Within six months, the number of motor vehicles entering the zone during fee hours had dropped 16 percent, congestion had decreased 30 percent and the time required for trips in and out of the C zone had fallen 14 percent. About 15,000 new passengers boarded buses, boosting transit income by £68 (about $130 million).[3] On January 3, 2006, Stockholm, Sweden adopted a C charge on a trial basis un til Jauly 31. In September, 2006, the charge was put a vote on whether to make the charge permanent. In answer to the question: "Should congestion tax be used in Stockholm?", 53 percent voted yes and 47 percent no, making the Swedish capital the first European city with majority approval of a road user charge.[4]

Scientists reviewing the London charge said the health benefits from reductions in air pollution were "modest," but a "welcome side-effect."[5] Spurred by the successes in Stockholm and London, other cities have begun evaluating C charges. In New York City, the idea was spiked by the state legislature,[6] while Milan, Italy, adopted a toll that varies according to how polluting a vehicle is.[7]

Sharing: Wheels When You Want Them

Whether it's cars, bicycles or something else, the net result of sharing vehicles is the same: some are removed from the road, cutting pollution. Parts of the reduction are direct—cars create pollution, bikes don't. Other parts are indirect: traffic jams, like stop-and-go driving, are eased, reducing pollution, and cars are taken off the road. According to one study, car sharing typically reduces average vehicle use 40 to 60 percent by drivers who use it.[8]

Sharing programs are wildly popular. ZipCar, which is just one of many companies in the business, started in 2000 and by 2008 was boasting 200,000 members in 50 markets in the United States, Europe and Canada, – up from 50,000 members in 10 markets in May 2006.[9] The company was posting 100 percent growth annually and had become a $100 million firm by 2008.

Figure 3 "Car sharing," in which several people use one car, is available commercially through a number of companies (above is a ZipCar). Cars are rented for a few hours for a fee—$8 per hour or $60 per weekday in Ann Arbor, Michigan, for example—that covers gasoline, maintenance and insurance costs. In one study, of program members, 15 percent gave up a car when they joined and 25 percent avoided buying one. One shared car equals six removed from the road. (Source: Coalition for Smarter Growth)

Under Zipcar's car sharing system, which is typical, members pay both a one-time application charge and a yearly fee. A member reserves a vehicle online, and then enters it by swiping an access card. Keys are stored inside the car, and when a driver is done, he or she returns the car to the pickup site, usually a private spot in a parking lot or garage. The rental fees cover gasoline, maintenance and insurance costs. Compact Zipcars typically rent for as low as $8 per hour or $60 per weekday in smaller markets such as Ann Arbor, Michigan, to about $10.50 per hour or $73 per weekday in New York City.[10] (A list of programs can be found at http://www.carsharing.net/where.html.)

Two Wheel Sharing Too

Then there's the Vélib—short for Vélo Liberté, or Freedom Bike—a system that seems to have started in Lyon, France, but is now rapidly spreading throughout the world. It is about sharing bicycles, sometimes for no cost whatsoever. In Paris, The Vélib Service Points—places where bicycles are picked up and returned—are about 300 yards apart and bikes are available 24 hours a day, seven days a week.[11]

Within two months after the start of the Vélib system, the self-service bicycles had clocked 3.7 million rides and seemed to have changed the way people moved throughout Paris.[12] City streets were "swarming with rental bikes. Everyone from tourists, to businessmen seems to be commuting or just enjoying the city on two wheels," according to one reporter.[13]

In February 2008, London's mayor announced that the British city would start a similar program, with bicycles available at street-corner stands under a roughly $1 billion (£500million) program that would station about 6,000 bikes in central London, with stalls about 300 yards (300 meters) apart.[14] Other programs started in Barcelona, Spain; Vienna, Austria; Berlin, Germany; and, Washington, D.C.[15]

The Washington, D.C. "SmartBike" program is the first in the United States. Members pick up and drop off bicycles that roughly resemble a cross between a folding bike and a BMX, with a metal basket on the front. It started with 120 red three-speed bicycles that, for an annual fee of $40, can be rented for as long as three hours at a time for an unlimited number of rentals. The Washington, D.C. suburb of Arlington, Virginia is also considering a bike-sharing program.[16]

Bike sharing programs are not new, but successful ones are. What seems to be fueling the new initiatives is the willingness of advertisers to pay for them in exchange for the rights to post their ads. In Washington, for example, program costs are covered by Clear Channel Outdoor, which in exchange receives exclusive advertising rights to bus shelters. Other successful programs deserve honorable mention.

Amsterdam is known as the "biking capital of the world." Some 40 percent of the city's traffic is said to be from bicycles. Its infrastructure is in large part designed to accommodate cyclists, and construction has long since begun on a 10,000-bike parking garage at the city's main train station.[17]

Figure 4 On July 15, 2007, Parisians awoke to discover thousands of low-cost rental bikes at hundreds of high-tech bicycle stations scattered throughout the city, an ambitious program to cut traffic, reduce pollution, improve parking and enhance the city's image as a greener, quieter, more relaxed place. The 20,600 rental bikes are at 1,450 locations. The user swipes a credit card, releasing the bike for use free for 30 minutes and for a small charge for more time, then drops it off at any location.

Copenhagen has free public bikes, extensive bicycle lanes separated from the main roads and unique bike-zone signal systems. The Danish capital has long been a cyclist's heaven. Users of the not-for-profit system have to provide a deposit of 20 kroner (about $4), which is returned when the bike is taken back to one of the many racks in the city. One neighborhood, Christiana, is car-free. A total of 32 percent of residents cycle to work.[18]

The biking craze is also spreading to the Middle East. In 2008, the Tel Aviv municipality announced an international tender for the creation of a system in which 1,500–2,000 bicycles will be available for hire in 100 spots throughout the city.[19]

At least one firm has taken the sharing concept further: Intrago offers small-sized, electric-powered vehicles as well as traditional bicycles. In Seattle, Washington—not the most bike-friendly city because it's built on a number of extremely steep hills and has lots of rain —the company teamed with the University of Washington to offer a vehicle sharing service on campus beginning in the fall of 2008 . "However, unlike the cars and crossovers typically offered by services like ZipCar and FlexCar," notes Autoblog Green, "U-W will be setting up electric bicycles" at four stations around the campus. When participants need to get somewhere, they can grab a bike from one of the charging stations and return it when they're finished.[20]

SPRAWLING AIR POLLUTION

Portland, Oregon, does such a good job at urban planning that chagrined defenders of the oil and auto industries bitterly refer to it as "the People's Republic of Portland." They conveniently ignore the fact that a public vote in 1979 in the city and 26 other jurisdictions created the Portland Metropolitan Area, or Metro, an elected area-wide government with authority over land-use, transit systems, and other cross-jurisdictional issues.[1] Although the process has suffered some setbacks in the recent past due to campaigns launched by property "rights" advocates, Portland remains arguably the best demonstration of how limiting sprawl reduces air pollution.

The city is one of the few major metropolitan areas in the United States that has consistently pursued the objective of mixed use development combined with limits on growth and increased public transit. Light rail takes travelers from the airport to the virtually car-free downtown to easily walk to hotels, restaurants, shops, and parks, and to take the streetcar all around the Pearl District, downtown, and into the emerging South Waterfront District. An aerial tram links the area to the Oregon Health and Sciences University high atop Marquam Hill.[21]

Portland's transportation system has long been one of the best in the United States. In 2001, the city complemented its bus and light rail network, with a new, modern streetcar system running from the southern waterfront, through Portland State University north to nearby homes and shopping districts. The 2.4-mile system cost an impressive $56.9 million but has been a

---

[1] In 1992, Metro launched a Region 2040 Growth Concept process to plan for a population expected to double to 2.5 million in the next 45 years. The plan is expected to result in 15 to 20 percent less motor vehicle pollution in the region than more auto-oriented development would produce. The final 2040 Growth Concept, adopted in 1994, focused about two-thirds of expected future development within Portland's locally established urban growth boundary through infill, mixed use, and higher-density development, about one-third in compact neighborhoods near transit stations and corridors served by high-capacity rail. Personal auto travel leveled in Portland, nearly 5,000 new housing units were constructed in downtown and bicycle use increased from 1 to 2 percent of all trips.

magnet for new development attracting more than $2.3 billion in private investment. Interest in and applications to Portland State University jumped sharply, solidifying it as a institution of higher learning. The system has proved so popular that three extensions have been added since 2001.[22]

Figure 5 Air pollution fell twice as fast in Portland, Oregon than in Atlanta, Georgia—a "poster child" for sprawl, according to the local newspaper—from 1988 to 1997 because of public transit and city planning. (Source: U.S. Department of Health and Human Services)

As long ago as 1997, about 23 percent of downtown workers already commuted by transit, with more than 40 percent during peak periods. Partly because of the resultant lower driving rates, the city, unlike most, has experienced no violations of federal ozone standards since 1988. What's more, that compares to a prior violation record of one day out of every three to five days."[23]

The 2000 U.S. Census provides a detailed portrait of the impact of integrating land use, transit and growth in Portland. In addition to basic information on race and gender asked of all U.S. residents in April 2000, a 53-question-long form was sent to one in six households. Workers 16 or older were asked their job site addresses, how they got to work and what time they began their journey. Their answers revealed that Portland was among a handful of places where automobiles declined in importance. Bus commuting grew 41 percent, while the numbers of bicycle riders and people working at home each grew 54 percent.[24]

The 2007 Urban Mobility report prepared by the Texas Transportation Institute comparing over 85 urban areas found that Portland-area drivers were delayed about 14 percent less than the average and the city was 33rd in delays although it was 25th in population. Buses, trains and streetcars saved the metropolitan area 6.7 million hours of rush-hour delay—placing Portland 13th in the nation in savings because of public transportation use. Take away public transit, and the area's congestion delay would have been 21 percent longer.[25]

The air quality impacts of metropolitan planning and transit translate to reduced pollution, which, in turn, means better health. This is illustrated by comparing Portland with another fast-growing city, Atlanta -- described by one of the city's own newspapers as a "poster child" for sprawl.[26]

Much of Atlanta's runaway growth has been fed by the immense amount of inexpensive raw land available for development. As Atlanta's outer reaches have spread further and further from the city center, the daily per capita vehicle miles traveled have climbed steadily, jumping from 32.1 in 1992 to 35.8 in 1998.

In the five-year period from 1990 to 1995, the number of miles driven by Atlantans increased 63 percent faster than the population. In Portland, the population rose 2.1 percent, but the miles driven actually dropped by 9.5 percent. Portland may very well be the only U.S. city to break the link between increased population and driving.

This difference was reflected in levels of air pollution.

Figure 6 The New York City Council adopted a congestion charge similar to the successful program in London, but the state legislature spiked the proposal. When traffic was reduced in Atlanta during the 1996 Olympics, levels of air pollution dropped in lock step, as did doctor visits and hospitalization respiratory ills.

Due largely to tighter federal limits on emissions from cars and trucks, air pollution levels fell in Atlanta and Portland alike from 1988 to 1997. But in Portland, levels in the air fell much more sharply: concentrations of carbon monoxide, virtually all of which comes from cars, dropped 77 percent more in Portland than Atlanta. Ozone, or smog, fell 55 percent faster in Portland by one measure (one-hour concentrations) and 108 percent—or twice as fast—by another (8-hour concentrations).[27]

Reductions like these translate to real and measurable health benefits. There can be no doubt about this because of a natural experiment in, coincidentally, Atlanta. This occurred in 1996, when the summer Olympics were held there.

Anxious to lessen the typical summer levels of smog, some of the nation's worst, Atlanta officials asked drivers to park their cars. They also closed the downtown area to car traffic, added buses and trains, and aggressively promoted flexible work schedules, car-pooling, and telecommuting. It all worked.

Weekday 1-hour morning peak traffic counts in Atlanta decreased 22.5 percent overall during the Olympic Games, while public transit ridership rose 217 percent. Peak ozone concentrations fell by 13 percent, and so did visits to hospitals, doctors and emergency rooms for asthma complaints. Among children aged 1 through 16 in the Medicaid claims files, the number of asthma emergency care visits declined 41.6 percent. Among HMO enrollees, the decrease was 44.1 percent, while citywide hospitalizations for asthma were off 19.1 percent and visits to the two pediatric emergency departments dropped 11.1 percent.[28] (These improvements in public health occurred even though the levels of ozone and other pollutants were below the health-based standards established by the Environmental Protection Agency for criteria pollutants.[29])

The Olympics-related temporary reductions in Atlanta are roughly comparable to how much smog levels would have dropped if Atlanta had adopted a land use and transit system like Portland's. In other words, better planning and transit translates to lower pollution, which, in turn, means fewer visits to hospitals, doctors and emergency rooms.

Other studies—in Toronto, Canada,[30] Brisbane, Australia,[31] Paris, France[32], Houston, Texas[33] and Barcelona, Spain,[34] to name but a few—have confirmed this relationship between traffic volume and health. In short, mayors and council members who refuse, or even merely fail, to embrace sensible transit and planning programs are sending their own citizens to the hospitals and doctors' offices.

1. Frank Greve, “There is something that can be done about the traffic,” | McClatchy Newspapers, May 13, 2008.

2. Brennen D. Walsh, “Congestion Charging: Solutions for the Escalating Problem of Vehicle Miles Traveled,” December, 2003, National Commission on Energy Policy, Washington, D.C.

3. Brennen D. Walsh, “Congestion Charging: Solutions for the Escalating Problem of Vehicle Miles Traveled,” December, 2003, National Commission on Energy Policy, Washington, D.C.

4. “Stockholm votes ‘yes’ to congestion charging,” Sep. 28, 2006, European Federation on Transport and Environment, http://www.transportenvironment.org/Article219.html

5. “Congestion charge 'boosts health,'” BBC News, Feb. 28, 2008.

6. Orla Ryan, “New York assembly shelves Manhattan congestion charge,” *The Guardian,* April 8, 2008.

7. “Milan targets smog with road pollution toll,” Aug. 2, 2006 http://www.edie.net/news/news_story.asp?id=11899&channel=0.

8. Todd Litman, “Evaluating Carsharing Benefits,” Victoria Transport Policy Institute, Victoria, B.C., Canada, Dec. 7, 1999.

9. Bree Fowler, “Market Spotlight: Car sharing,” Associated Press, May 19, 2008. As of January 1, 2008 - based on data provided by Susan Shaheen, University of California, Berkeley - 18 U.S. carsharing programs had 234,483 members sharing 5,261 vehicles, and 13 Canadian programs had 33,895 members with 1,499 vehicles (increases of 75%, 45%, 55% and 51% respectively for 2007).

10. Bree Fowler, “Market Spotlight: Car sharing,” Associated Press, May 19, 2008.

11. http://www.en.velib.paris.fr/comment_ca_marche. For an excellent description of the system, go to http://www.pricetags.ca/pricetags/pricetags101.pdf

12. Eleanor Beardsley, “ Paris' Popular Bike Program May Inspire Others,” National Public Radio, May 21, 2008.

13. Eleanor Beardsley, “ Paris' Popular Bike Program May Inspire Others,” National Public Radio, May 21, 2008.

14. Ben Russell, “Livingstone plan for street-corner cycle hire stands,” *The Independent*, Feb. 12, 2008.

15. “Paris' Bike Rental System: A Global Revolution for City Cycling?” http://www.bikesbelong.org/node/215659.

16. Elissa Silverman, “Bicycle-Sharing Program to Debut,” *The Washington Post*, April 19, 2008.

17. Ben Russell, “Livingstone plan for street-corner cycle hire stands,” *The Independent*, Feb. 12, 2008.

18. Ben Russell, “Livingstone plan for street-corner cycle hire stands,” *The Independent*, Feb. 12, 2008.

19. Ben Russell, “Livingstone plan for street-corner cycle hire stands,” *The Independent*, Feb. 12, 2008.

20. “First Take: Check Out That Electric Bike,” University of Washington Alumni Magazine, March, 2008. Also, “University of Washington Selects Intrago Share E-Bike System,” eMedia Wire, Dec 01, 2007.

21. Tim Halbur, “Mecca for TOD - Making the Pilgrimage to Portland,” Reconnecting America, Center for Transit-Oriented Development, www.reconnectingamerica.org/public/story/194

22. Office of the mayor, Milwaukee, “Transit Trip Shows Milwaukee What's Possible,” July 18, 2007.

23. California Air Resources Board, *The Land Use-Air Quality Linkage*, 1997.

24. "Commuting to Work in Portland," http://movingtoportland.net/portland_commute.htm

25. Texas Transportation Institute, "2007 Urban Mobility Report and Appendices," http://mobility.tamu.edu/ums/report/

26. Rebecca Carr, "GRTA request for funds well received; Area fights image as sprawl 'poster child'," *The Atlanta Journal*, C9, Feb.11, 2000.

27. Curtis Moore, *Smart Growth and the Clean Air Act*, Northeast-Midwest Institute, Washington, D.C., 2001.

28. FRIEDMAN, M.S., POWELL, K.E., HUTWAGNER, L., GRAHAM, L.M., & TEAGUE, W.G. Impact of changes in transportation and Commuting behaviors during the 1996 Summer Olympic Games in Atlanta on Air Quality and Childhood Asthma
JAMA 2001: 285; 897–905
Comparison of the 17 days of the Olympic Games (July 19–Aug 4) to a baseline period consisting of the 4 weeks before and 4 weeks after the Olympic Games. Peak one-hour level of O_3 fell to 50–100 ppb during the games from a predicted value of about 70–120 in the comparison periods. PM_{10} (24 hour level) was 20–45, compared to levels of 30–70; NO_2 was only slightly lower running at about 30 ppb peak one-hour level compared to values between 20–65. CO also slightly lower. Traffic density measurements showed decreases of 22% in weekday 1-hour morning peak traffic counts during the Olympic Games. Ozone levels fell slightly over the same period in three different places 60 km to 100 km from Atlanta; but these changes were only about one fifth of the drop in Atlanta.

Citywide acute care visits and hospitalizations for asthma were logged. Results showed no changes in nonasthma diagnoses; decreases of 41% in Medicaid claims file, 44% decreases in HMO database; 11% decreases in two emergency pediatric departments; and decreases of 19% in Georgia Hospital Discharge Database. Lack of change in other diagnostic categories indicates that children did not leave Atlanta over the period of the Olympic Games.

29. One of the study's authors, Michael S. Friedman viewed it important because "it provides evidence that decreasing automobile use can reduce the burden of asthma in our cities and that citywide efforts to reduce rush-hour automobile traffic through the use of public transportation and altered work schedules is possible in America." Centers for Disease Control, "CDC study links improved air quality with decreased emergency visits for asthma," Press Release, Feb. 21, 2001, http://www.cdc.gov/od/oc/media/pressrel/r010221.htm.

30. BURNETT, R.T., SMITH-DORION, M., STIEB, D., RAIZENNE, M.E., BROOK, J.R., DALES, R.E., LEECH, J.A., CAKMAK, S., & KREWSKI, D.
Association between ozone and hospitalization for acute respiratory diseases in children less than 2 years of age
Am J Epidemiol 2001: 153; 444–452
15 year period 1980–1994 in Toronto (including 6 cities of Toronto, North York, East York, Etobicoke, Scarborough & York). Daily number of emergency or urgent hospital admissions for croup, pneumonia, asthma and acute bronchitis/bronchiolitis. Gastroentieritis used as control (second leading cause of hospitalization). Prediction equations, previously validated, used to predict $PM_{2.5}$ from TSP, and sulfates also used in the summer. LOESS nonparametric smoothing method. Adjustment for weather described, and temporal trends and day of the week effects taken out. Mean values for ozone 45.2 ppb; $PM_{2.5}$ 18 micrograms/m^3; $PM_{10–2.5}$ 16.2; NO_2 ppb 44.1; SO_2 ppb 11.8; CO ppm 1.9. Mean admissions/day for respiratory problems 2.9; mean GI admissions 1.2:
Percentage increase in daily admissions in May–August period was 14.2% associated with a 45.2 ppb increase in O_3 (daily one hour maximum) if lag of one day used. If lag of 2 days, was 13.2% increase. Based on five-day average, 45.2 ppb increase in ozone associated with 34.8% increase. This became 29.4% after adjustment for either $PM_{10–2.5}$ or NO_2. Correlation of O_3 with $PM_{2.5}$ was 0.58 and with NO_2 was 0.52; with CO was 0.24.

Increases for asthma were 31.3%; croup 45.3%; acute bronchitis/bronchiolitis 45.7%; and 23.3% for pneumonia. Note of CO relationship since this showed strongest relationship after adjustment for ozone.

31. PETROESCHEVSKY, A., SIMPSON, R.W., THALIB, L., & RUTHERFORD, S.
Associations between outdoor air pollution and hospital admissions in Brisbane, Australia
Arch Environ Health 56; 37–52; 2001
Period of study was 1987–1994. Total of 41,127 emergency admissions for cardiovascular disease, and 33,710 respiratory admissions which included 13,246 for asthma (constituting 39% of all respiratory admissions). All public hospitals in Brisbane area included. Air pollution data from 7 stations, measuring ambient levels every half-hour. 24-hour averages and maximal 1 hour concentrations used in analysis, but an 8-hour average used for ozone.

Statistical analytical methods exactly followed the APHEA protocol, which is described in some detail. This is an iterative model-building process after correction for more than 60 day temporal cycles. Abstract notes: "Ozone was consistently associated with admissions for asthma and respiratory disease—with little evidence of a threshold. In two pollutant models, the ozone effect was relatively unaffected by the control for high levels of other pollutants. Particulate pollution (measured by nephelometry) was associated positively with admissions for respiratory disease and admissions for asthma in summer, whereas a negative association was observed for cardiovascular admissions". SO_2 was associated with admissions for the control diagnosis of digestive disorders.

Note that ozone levels were similarly elevated throughout the year, with mean 8-hour levels being 1.99; 1.67; 1.61; and 2.23 pphm in summer; autumn; winter and spring, respectively. Mean 24-hour NO_2 levels were 0.97; 1.29; 1.79; and 1.53 pphm in the same seasons. NO_2 was not associated with hospital admissions. Risk ratios for asthma admissions in age groups 0–14; 15–64; and for total asthma were 1.064; 1.084; and 1.090 for a unit increase (pphm) in 8-hour ozone. This represents a 9% increase in asthma admissions per 1 pphm increase in ozone. Figure of RR for asthma all ages versus average 8-hour O_3 lagged 2 days is linear from 1.0 to 3.0 pphm with no evidence of a lower threshold.

32. DESQUEYROUX, H., PUJET, J-C., PROSPER, M., SQUINAZI, F., & MOMAS, I.
Short-Term effects of low-level air pollution on respiratory health of adults suffering from moderate to severe asthma
Environmental Research Section A; 89; 29–37 (2002)
60 severe asthmatics mean age 55 studied over 13-month period. Criteria included attendance at Center for Treatment of Respiratory Diseases in Paris, and included more than 15% increase in FEV1 after beta2 agonist inhalation; more than 20% FEV1 fall after provocative dose of methacholine; recurrent wheezing and physician certified moderate to severe asthma. Daily values of SO_2 from 28 sites; for PM_{10} from 7 sites; for NO_2 from 15 sites; and from 6 sites for O_3. Each subject seen by a physician at each consultation whether scheduled or emergency. An asthma attack was defined as the need to increase twofold the dose of inhaled beta2 agonist and confirmed by clinical examination.

Odds ratio for risk of an asthmatic attack per 10 microgram/m^3 increase in PM_{10} was 1.41. An increase of 10 microgram/m^3 (5 ppb) of ozone was associated with an OR of 1.20. 3–5 day delay for PM_{10} but 2 day delay for O_3. No association with NO_2 nor with SO_2. Convincing and clinically thorough panel study.

33. BAG, R., FROLOV, AQ., KEYS, J., ZIMMERMAN, J.L., & HANANIA, N.A.
Association between ambient ozone levels and emergency department (ED) visits for asthma in Houston, TX, USA
Am J Respir Crit Care Med 161: A308; 2000
Adult visits for asthma (> 17 years) recorded. 7982 asthma visits with 4214 during the ozone high months. Mean age 41.6 years; 61% were women. In ozone months, mean values were 36.8 ppb as 8 hour average and 50.8 for 1-hour maximum levels. 71 days with 8-hour average above 0.08 ppm. Significant association between ozone levels and ED visits in the ozone months.

34. SUNYER, J., BASAGANA, X., BELMONTE, J., & ANTO, J.M.
Effect of nitrogen dioxide and ozone on the risk of dying in patients with severe asthma
Thorax 2002: 57; 687–693
Patients over the age of 14 who died during the period 1985–1995 in Barcelona who had visited the emergency department of one of the four largest hospitals in the city for asthma during 1985–1989. Total of 467 men and 611 women. "Air pollution was measured at the city monitoring stations which provide a mean for the entire city." Daily values of PM_{10} appears to have a mean value of 61.2 micrograms/m3; Black smoke 40.0; 1-hour NO289.7 micrograms/m^3; 24-hour NO_2 52.3 micrograms/m^3; 1-hour ozone 69.3 micrograms/m^3; 8-hour ozone 54.4 micrograms/m^3; SO_2 18.8 micrograms/m^3; Pollen and spores recorded weekly and measured by 'the Cour method'. Thought to be accurate for pollen grains, but fungal spores get damaged and are underestimates.

For cases with more than one admission always for asthma, the odds ratio for interquartile change was as follows:

NO_2 1.688 (1.074 to 2.652): Ozone 1.755 (0.984 to 3.133) with 95% confidence limits in brackets. These values were not much changed by correction for total pollen and for spore counts. "Patients with severe asthma—that is, those with more than one admission to the emergency department for an asthma exacerbation—had a higher risk of dying on days with higher levels of NO_2 regardless of the season, and O_3 in the warm season. These associations were not confounded by the weekly levels of pollen and fungal spores."